2020
ANNUAL REPORT

NATIONAL NANOTECHNOLOGY RESEARCH CENTER

INSTITUTE OF MATERIALS SCIENCE AND NANOTECHNOLOGY

unam excellence in science and technology

İhsan Doğramacı Bilkent University
Bilkent
1984

ABOUT UNAM

As UNAM, we are conducting cutting-edge R&D and innovative P&D projects in the fields of nanoscience, biotechnology, and material sciences. Our aims are to generate quality scientific knowledge, with our focus on science, social benefit, innovation and our "national lab" identity. We work to produce new development, added value, qualified workforce and international level of knowledge and technology, through university-industry cooperation, that will be beneficial to the world and humanity.

With our distinguished academic staff and world-class research infrastructure with over 400 instruments, we are boasting an 'open lab' concept that provides a vibrant R&D environment in a transdisciplinary ecosystem for approximately 400 researchers to deliver top-tier scientific work.

UNAM, which has been selected for a special large-scale program under the Law no. 6550 Research Infrastructure Support, serves as a national lab for over 1500 users from academia and industry. It has contributed to the commercialization of many high technology products (96 patents), more than 1400 SCI and 251 Nature Indexed journal publications.

Build the Future

unam excellence in science and technology

imagine.

think.

work.

challenge.

inspire.

unam.

smile.

UNAM is supported under Law no. 6550. UNAM would like to thank **Ministry of Industry and Technology, Ministry of Education, Presidency of Strategy and Budget, Board of Education and Teaching Policies, Board of Science, Technology and Innovation Policies, Council of Higher Education, and The Scientific And Technological Research Council of Turkey** for this support.

UNAM MISSION

Our Mission at UNAM, standing on the edge of knowledge and for global competitiveness, is to achieve **excellence** in nanoscience-nanotechnology, materials science and engineering, and all related fields through:

01

Generating high-impact, new knowledge to be transformed into societal and economic benefits

02

Training qualified human resources to grow into leaders of the future and

03

Developing value-added high-tech platforms and advanced R&D capability and competency

At UNAM, our Motto is thus:

Excellence in Science and Technology

UNAM VISION

In line with UNAM Mission, our Grand Vision consists of:

01

- Lead world-class science-technology center and knowledge community
- Pioneer competent infrastructure sustainable at world standards
- Spearhead globally successful 'national lab' model and human-centered, institutionalized and professional management

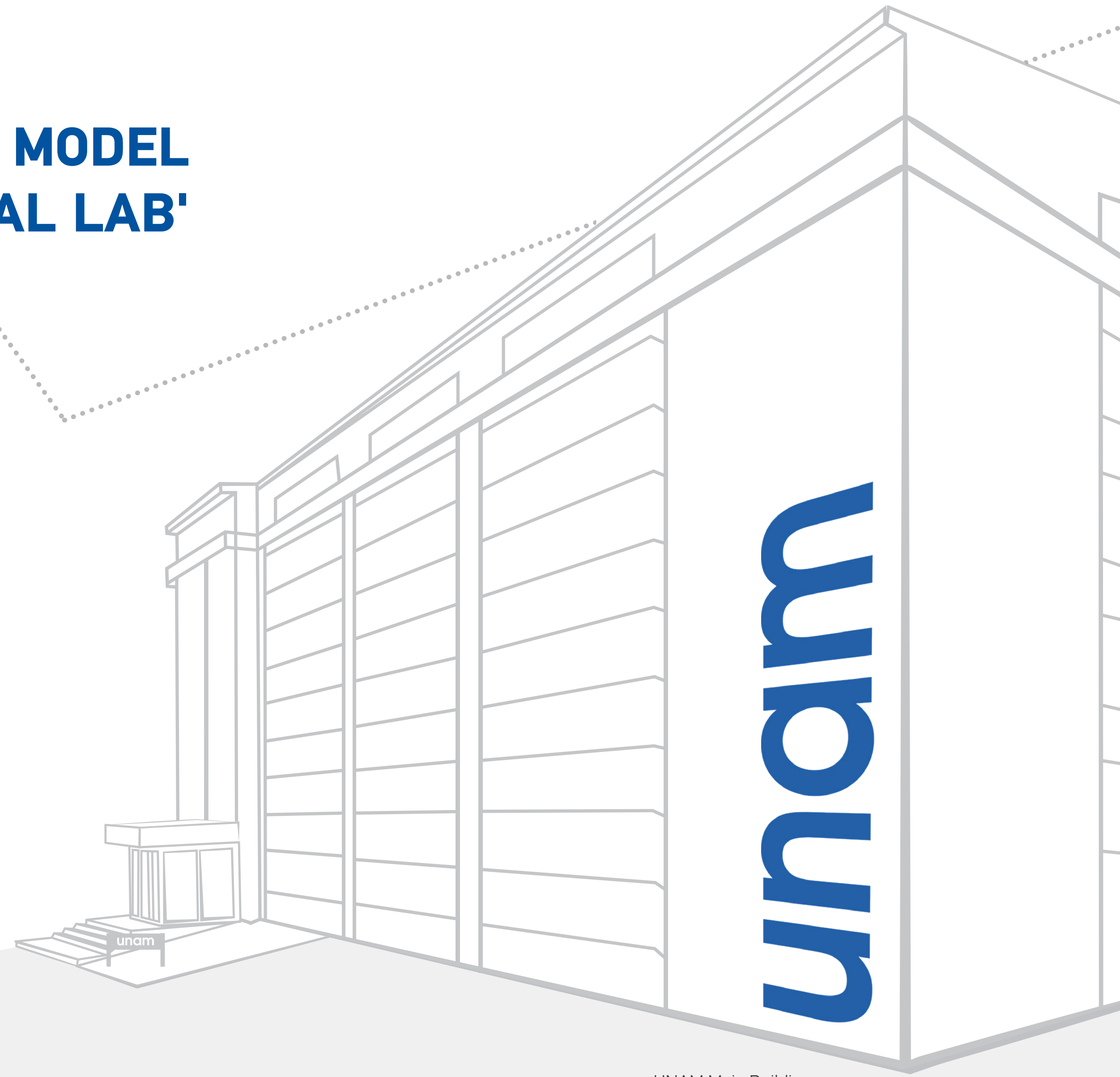
02

- Groom academic and technical leaders of the future
- Foster graduate education and cutting-edge R&D at **Bilkent University Institute of Materials Science and Nanotechnology (MSN)**, attract talents, and train qualified R&D workforce
- Promote technical hands-on trainings of advanced techniques using infrastructure

03

- Shape future R&D via generating creative ideas and quality knowledge in nanoscience-nanotechnology, materials science and engineering, and all related fields
- Leave marks in R&D landscape by transforming ideas and knowledge into societal and economic benefits
- Flourish high-tech ecosystem and ensure the success and continuity of UNAM enterprise with systematic innovation

UNAM MODEL AS A 'NATIONAL LAB'



UNAM Main Building

TODAY'S UNAM

Executive Summary

Bilkent University UNAM was established in 2007 as a National Laboratory in Bilkent to develop international scientific and technological excellence in disciplines such as material sciences and engineering, electrical and electronic engineering, mechanical engineering, physics, chemistry, molecular biology, under the umbrella of nanoscience and nanotechnology. Later, it became one of the first four National Research Centers in Turkey, receiving qualification on August 16, 2017, within the scope of the Law No. 6550 on the Support of Research Infrastructures.

Bilkent University UNAM provides a vibrant transdisciplinary ecosystem with a distinguished academic staff (53 academic staff), its advanced research infrastructure (over **400 instruments**) that supports the 'open lab' concept, and **421 researchers** and staff to carry out scientific studies at the highest level on an area of **10.464 m²**. The success of UNAM academic staff has been certified with funding programs such as ERC (European Research Council), EMBO (European Molecular Biology Organization) and NIH (United States National Institute of Health), national academic memberships and **153 awards**, 78 of which are national and 75 international.

As a metric of quality, **293 articles** were published in Nature Indexed journals from Bilkent University UNAM. UNAM, which has the most articles published in these journals in Turkey so far as a "national lab", owns 7.2% of all publications.

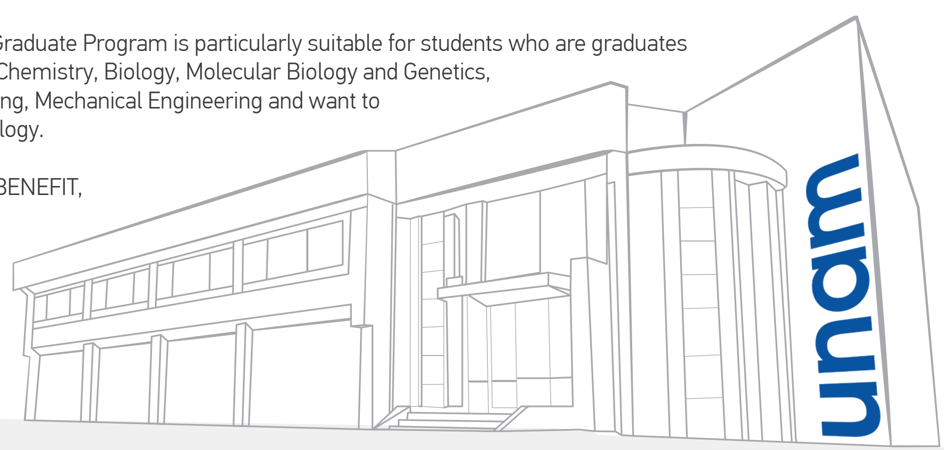
Bilkent UNAM, which was selected for a special large-scale program within the scope of the Law No. 6550 on the Support of Research Infrastructures, develops its own research structure with a budget of more than 100 million TL. With this support, Bilkent UNAM serves as a national lab to over **1700 users** with 116 universities from the academy and 114 companies from the industry.

Nevertheless, UNAM has contributed to the commercialization of many high-tech products with the birth of **25 spin-off companies** and a total of **122 patent registrations**, 50 of which are national and 72 international. While managing **277 R&D projects** with its intensive and successful R&D program so far, thanks to the Bilkent University Materials Science and Nanotechnology (MSN) Graduate Program within UNAM, **541 thesis studies** were completed, and **264 graduate** and doctoral students were graduated with the aim of training highly qualified researchers. Today, Bilkent UNAM graduates are the scientists sought in R&D studies.

Materials Science and Nanotechnology (MSN) Graduate Program is particularly suitable for students who are graduates of Materials Science and Engineering, Physics, Chemistry, Biology, Molecular Biology and Genetics, Electrical and Electric and Electronics Engineering, Mechanical Engineering and want to pursue careers in nanoscience and nanotechnology.

At UNAM, with our focus on SCIENCE, SOCIAL BENEFIT, INNOVATION and our "national lab" identity, we work to produce new development, added value, qualified workforce and international level of knowledge and technology that will be beneficial to the world and humanity.

UNAM Director's Office



UNAM ARL Building

unam excellence in science and technology GOVERNANCE

UNAM Governance counts on an independent Board that consists of prominent members

UNAM BOARD OF GOVERNANCE


ADNAN AKAY


ABDULLAH ATALAR


METE ÇAKMAKCI


HİLMİ VOLKAN DEMİR


FARUK ECZACIBAŞI


VAHİT ERDEM


ATAÇ İMAMOĞLU


HİTAY ÖZBAY


ANIL YILMAZ

DIRECTOR'S MESSAGE

unam excellence in science and technology

NATIONAL NANOTECHNOLOGY RESEARCH CENTER

INSTITUTE OF MATERIALS SCIENCE AND NANOTECHNOLOGY

"Knowledge is power"

There exists a never-ending transnational competition of knowledge. Whatever we do, or do not do, the questions remain: Where do we stand now? And where shall our next generations continuously be in this competition?

Bilkent UNAM stands out as an excellence peak of knowledge in this country and the region and is connected via super highways to many peaks of excellence around the globe. To serve this purpose as a National Lab, Bilkent UNAM should and will continue generating cutting-edge knowledge and developing pioneering technologies, and grooming leaders of the future.

To this end, UNAM's mission and vision are clearly outlined in universal values along with the action steps essential to achieving them. In this journey, the most critical assets for accomplishing these strategic goals are our People and the value we give to them.

In this journey, for their continuous support to reach our strategic goals, we gratefully acknowledge Turkish Republic Ministry of Industry and Technology, Ministry of Education, Presidency of Strategy and Budget, Board of Education and Teaching Policies, Board of Science, Technology and Innovation Policies, Council of Higher Education, and The Scientific And Technological Research Council of Turkey. Also, we bestow our deepest thanks to our Board of Governance members for their visionary contributions as our institutional pillars and all of our colleagues ans students who have made critical concibutions towards the direction of excellence in science and technology.

Professor Hilmi Volkan Demir
Chair of UNAM Executive Board
Director

Advanced Materials
(Cover)
DOI: 10.1002/
adma.202170070

Contents

UNAM by Numbers

01

10.464 m^2

02

87 LABORATORIES

03

153 AWARDS
78 NATIONAL
75 INTERNATIONAL

07

122 GRANTED PATENTS
50 NATIONAL
72 INTERNATIONAL

08

421 RESEARCHERS
AND STAFF

09

OVER 1,700 USERS

UNAM by Numbers

04

539 THESES COMPLETED at UNAM

05

277 R&D PROJECTS
8 ERC PROJECTS

6

25 STARTUPS

10

1,500 SCI PUBLICATIONS

11

293 NATURE INDEX JOURNAL PAPERS (No.1 in Turkey as a National Lab)

12

193 JOURNAL PAPERS with IMPACT FACTOR > 10

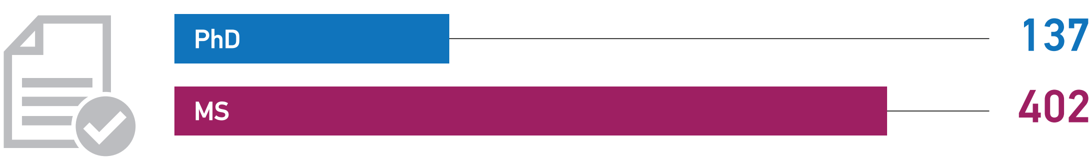
UNAM by Numbers

GRADUATE STUDENTS
TOTAL **264**

MSN
- PhD - 35
- MS - 59

OTHER DEPARTMENTS
- PhD - 26
- MS - 80
- BS - 64

NUMBER OF COMPLETED THESES
TOTAL **539**

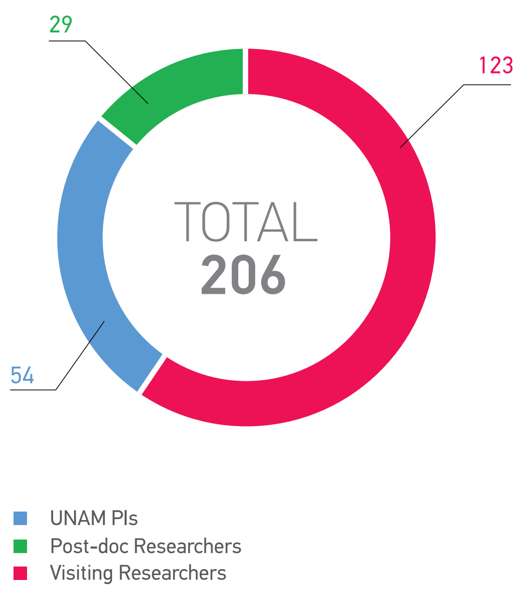


MSN
- PhD - 70
- MS - 142

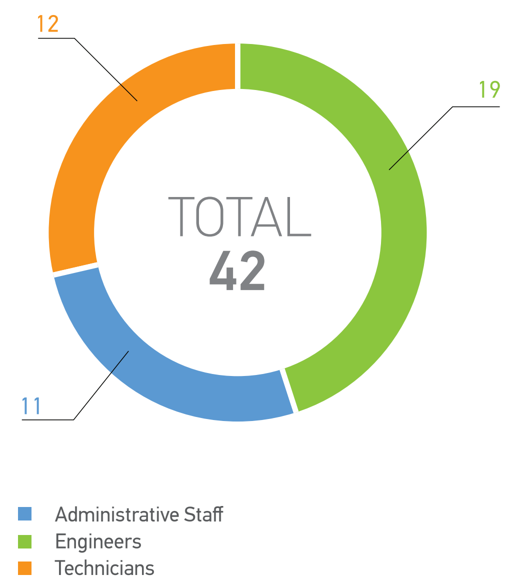
OTHER DEPARTMENTS
- PhD - 67
- MS - 260

UNAM by Numbers

RESEARCHERS WITH PhD



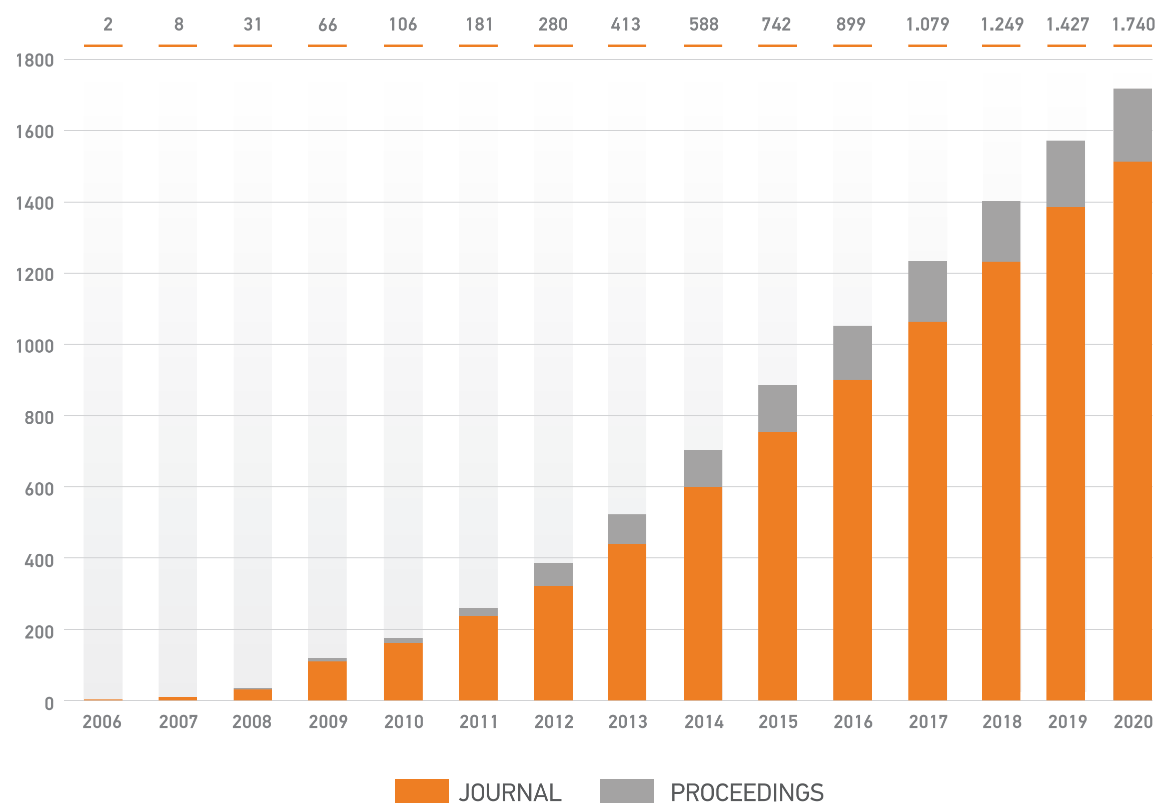
ADMINISTRATIVE AND TECHNICAL SUPPORT



UNAM by Numbers

Average
citations per paper
28,28

TOTAL JOURNAL PUBLICATIONS
1.740



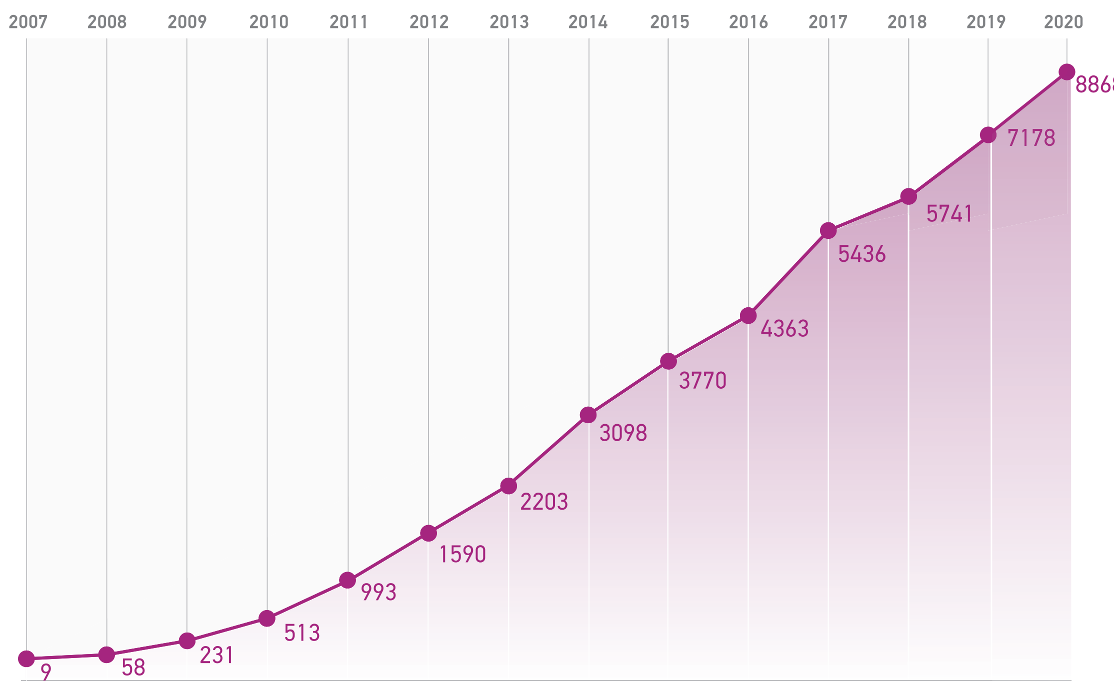
UNAM by Numbers

SUM OF TIMES CITED

49,207

Without self citations

44,359



UNAM Buildings

10,464 m²
Total Space

UNAM supports a wide range of scientific research and technological development in two buildings (UNAM Main Building and UNAM ARL Building) plus a separate laboratory (High-Precision Manufacturing Laboratory), with over 400 instruments, 87 laboratories and two separate cleanrooms of 856 m², covering a total space of 10,464 m².

The UNAM Main Building has been organized to provide different core capabilities on different floors.

- 05 Life Sciences
- 04 Nanochemistry
- 03 Nanomaterials, Nanodevices
- 02 Nanophotonics, Nanoelectronics, Nanomechanics
- 01 Laser and Spectroscopy
- G Nanofabrication, Microfabrication (Cleanroom)
- B Nanoimaging, Nanofabrication & Characterization

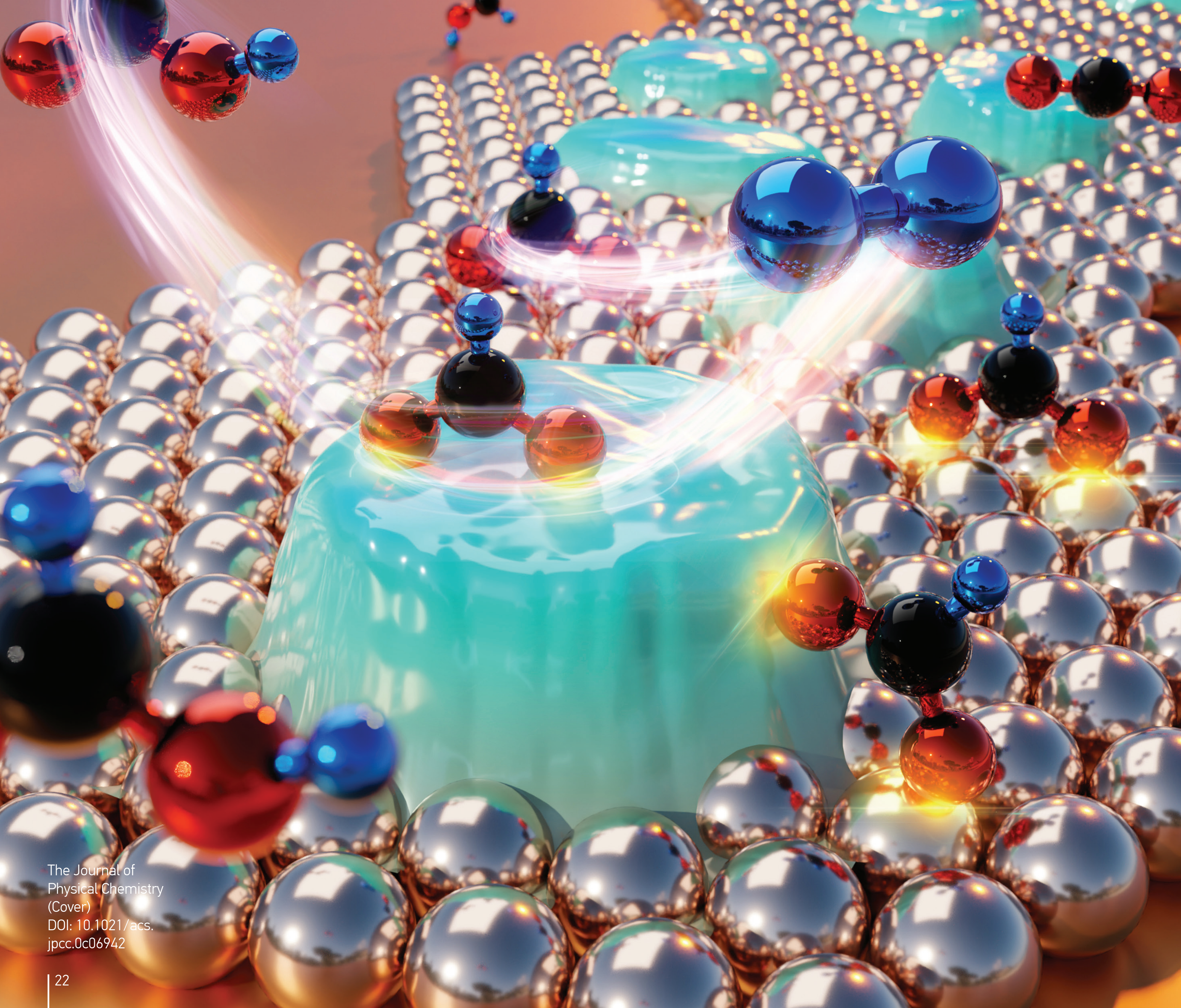
As a National Lab, UNAM is continuously growing and reaching out to more scientists and researchers every year. This growth reflects itself in the scientific outputs and technological outcomes of our center.

UNAM facility has been utilized by more than **1,700 users** in total, with **400 group users** and **1,300 hour-rated users.** As the numbers of UNAM researchers and projects are increasing, UNAM is becoming a central hub for high-impact research and talent attraction.

TOTAL
87 Laboratories

UNAM ARL
(Advanced Research Lab) Building

01 Officies
G Cleanroom
B Labs



The Journal of Physical Chemistry (Cover)

DOI: 10.1021/acs.jpcc.0c06942

DIRECTOR'S OFFICE

The UNAM Directorate carries out activities related to coordinating and running administrative and academic operations, keeping the infrastructure working and up-to-date, facilitating scientific research and technological development, initiating collaborations with academia and industry, ensuring financial sustainability, managing human resources, and creating and implementing strategies.

HİLMİ VOLKAN DEMİR
Director

ÖZGÜR YILDIRIM
Associate Director
(Operations, Innovation)
Infrastructure Manager

T. SERKAN KASIRGA
Associate Director
(Academic Affairs, Academic Strategies)

DÖNÜŞ TUNCEL
Associate Director
(MSN Graduate Program, MSN Alumni)

UNAM Administrative Staff

DUYGU BERBEROĞLU
Industry Cooperation and Technopreneurship

SELİN ESENERGÜL BİRLİK
Communication

FATİH BÜKER
Safety, Maintenance

MURAT DERE
Facility

MUSTAFA DOĞAN
Information Technologies

METE DUMAN
Graphic Design

FUNDA EKER
Procurement

MUHAMMED EMİN GÜRBAY
Maintenance

DUYGU KAZANCI
Administration

SEHER ŞEN
Procurement Accounting

UMUT SİNANOĞLU
Accounting

AYŞEGÜL TORUN
Human Resources, MSN Graduate Program

OLCAY ÜNDAL
Finance

SONGÜL ZEYBEK
Finance

UNAM Operations Team


SEDA AĞAR
Engineer


ALİ ONUR AŞAP
Biologist


OYA BAL
Engineer


SEMİH BOZKURT
Engineer


ZEYNEP ERDOĞAN
Team Leader


MUSTAFA GÜLER
Team Leader


MURAT GÜRE
Team Leader


CAN GÜVEN
Engineer


TAHA ILIKKAN
Engineer


ABDULLAH KAFADENK
Technical Specialist


ÖVÜNÇ KARAKURT
Engineer


ESRA ARMAN KARAASLAN
Engineer


ERGÜN KARAMAN
Technician


MUSTAFA ÖZER
Technician


FİKRET PİRİ
Technician


ZEHRA VELİ
Engineer

UNAM Innovation Team

ALİ KARATUTLU
Engineer

ELİF YAPAR YILDIRIM
Engineer

LEVENT ERSOY
Technician

SEYIT ALİ YAŞAR
Technician

VOLKAN DEMİR
Team Leader

Views about **UNAM**

"... The 'Optimal of Turkey' requires the improvement of very comprehensive and multi dimensional strategies in science, culture, education, technologies, economy, political will, ethics and value systems. The nanoscience and nanotechnology contribution will be to move to the upper strata, the socio-economic trends as a very important subset and be a catalyst in the system by providing multifactorial, multisectorial productivity and value added increase. The National Nanotechnology Research Center – UNAM takes place on the upper strata of this search in converging to the 'Optimal of Turkey' and to the highest international science targets..."

***Dr. Orhan Güvenen**, Professor*
Bilkent University and UNAM

"... During my PhD study I have visited and collaborated with numerous research labs around the world, from South Korea to Singapore, Germany to USA. I have always felt very proud to say that among all these institutes that I have been to, UNAM is definitely one of the best. UNAM's world-class research infrastructure and facilities within a single building make it an extremely productive environment for the researchers from various backgrounds to do cutting-edge research. At UNAM, researchers can synthesize new materials, study their emerging physical, chemical and biological properties and also fabricate prototype devices based on these nanomaterials without leaving the building. Therefore, UNAM fosters scientific excellence and empowers its researchers to become world-leading experts. Overall, I feel very grateful for all resources UNAM provides..."

***Dr. Burak Güzeltürk**, Bilkent University EE PhD and UNAM'16*
Currently, Postdoctoral Researcher at Stanford University
CA, USA

Views about **UNAM**

"... I completed my doctoral studies at UNAM within the scope of Materials Science and Nanotechnology program between 2012-2017. During this time I had the opportunity to work with researchers from different disciplines and carry out all my scientific ideas. I feel very lucky to be a member of an institute which has been recognized and followed by many researchers all over the world. I would like to thank UNAM for offering me this opportunity..."

***Dr. Melike Sever**, Bilkent University MSN PhD and UNAM'17*
Currently, Postdoctoral Researcher at Hacettepe University

"... I was very interested in the high-impact work done at UNAM, both experimentally and theoretically, in various areas of physics, chemistry, and materials science. I was particularly impressed by the work done in the areas of computational materials science, advanced optics and optoelectronics, and the theory and practice of self-assembly and soft materials. I see many areas of common interest with Weizmann Institute scientists and look forward to future collaborations..."

***Dr. Leeor Kronik**, Professor*
Weizmann Institute of Science
Israel

"... During my PhD, I had the opportunity to access the unique intellectual ecosystem and experimental infrastructure of UNAM. Together with the world-class research facilities, a transdisciplinary research environment of UNAM has provided us with tremendous opportunities to conduct cutting-edge research and become well-trained scientists by acquiring a significant level of new knowledge and technical/scientific skills and broadening our horizon. Therefore, I feel very lucky to be a graduate of UNAM..."

***Dr. Yusuf Keleştemur**, Bilkent University MSN PhD and UNAM'17*
Currently, Postdoctoral Researcher at ETH Zürich
Switzerland

Views about **UNAM**

"... I am impressed by the achievements of UNAM Nanotechnology Research Centre of the Bilkent University. UNAM has strong faculty and a lot of enthusiastic young students and postdocs working at the forefront of nanotechnology research..."

***Dr. Andrey L. Rogach**, Professor*
ACS Nano Editor
City University of Hong Kong
Hong Kong

"... During my PhD I had the opportunity to access to the world-class research facilities of UNAM. The friendly working environment as well as the rich research equipment helped us to pursue high-quality research. While working at the University of Cambridge, I can clearly see that we –the graduates of UNAM– are capable of conducting world-class research and competing with the leading research institutes of the world since we have all the necessary training, talent, and self-confidence that are needed. Therefore, I fell very lucky to be a scientist who has been trained at UNAM..."

***Dr. Talha Erdem**, Bilkent University EE PhD and UNAM'16*
Currently, Postdoctoral Researcher at University of Cambridge
UK

"... It is my great pleasure to report that UNAM today represents a very nice assembly of young and very active researchers with pronounced leadership and intuition on innovation, they keep on very creative and friendly atmosphere with high research grade and strong technology-oriented spirit. No doubt, we shall witness new achievements from UNAM in the future!..."

***Dr. Sergey Gaponenko**, Professor*
Scientific Director of the Nanophotonics Center
Stepanov Institute of Physics, Member of National Academy of Sciences of Belarus
Belarus

Views about **UNAM**

"... The richness of the scientific environment at UNAM offers an unparalleled opportunity for PhD candidates. If your main area of study transcends the classical definitions of physics, chemistry and biology, UNAM is your place to study. UNAM promotes a rich social environment for early career scientists, opening new avenues for collaborative research. The level of research at UNAM is competitive with the other world class research institutions..."

***Dr. Tolga Tarkan Ölmez**, Bilkent University MSN PhD and UNAM'17,*
Currently, Postdoctoral Associate at Yale University
CT, USA

"...UNAM provides a multidisciplinary and dynamic work place. Students are allowed to use instruments on their own. Therefore, I have gained lots of experience on almost any characterization equipment located at UNAM during my PhD. Today, Nanodev Scientific, which I founded as a spin-off from UNAM, manufactures high-tech optical characterization tools and instruments and I am using my wonderful experience and training at UNAM to guarantee the quality of our products..."

***Dr. Okan Önder Ekiz**, Bilkent University MSN PhD and UNAM'15*
Founder and CEO of Nanodev Scientific

"... I was very impressed by the high-level of commitment, which requires considerable investment in research infrastructure and in maintaining these expensive research resources. I was very pleased to hear that students training and research is based on hands-on experience, which is not always the case elsewhere. I was also very pleased to hear that UNAM researchers are deeply involved in international collaborations. I was also very delighted to hear of the successful participation of UNAM researchers in the highly competitive Horizon 2020 EU research program, and most particularly in the prestigious ERC grants..."

***Dr. Reshef Tenne**, Professor (Emeritus)*
Weizmann Institute, Member of the Israeli Academy of Sciences and Humanities
Israel

Views about **UNAM**

"... I worked as a PhD student and postdoctoral researcher from 2012 to 2017 at UNAM. It was a privilege to be part of such a pioneering research institute with world-class staff, facilities and infrastructures. In my opinion, UNAM does not only provide scientific environment for ground-breaking research but also opens new doors for young researches to develop new scientist ideas and integrate with international scientific society. I hope UNAM will keep growing with new achievements..."

***Dr. Mohammad Aref Khalily**,*
Bilkent University MSN PhD and UNAM'17
Currently Postdoctoral Researcher at MESA+ Institute for Nanotechnology, Twente University
Netherlands

"... I found the UNAM institute impressive and highly talented. The staff is of the highest caliber in technology and research abilities and the research work that takes place at UNAM is inspiring and of revolutionary and pioneering nature. Ankara is blessed to have the UNAM Institute on its premises and the population in the region are very lucky to have the opportunity to get educated there..."

***Rafi Nave**, The Bronica Entrepreneurship Center Former Director*
The Samuel Neaman Institute, Technion
Israel

"... I obtained different academic perspectives, in addition to my biology background, with the variety of courses offered in UNAM and the opportunity to be in contact with all research groups of diverse expertise at UNAM..."

***Dr. Canan Kurşungöz**,*
Bilkent University MSN PhD and UNAM'17

Prizes & Awards

Prizes & Awards

HİLMİ VOLKAN DEMİR

Dept. of Electrical and Electronics Engineering, Dept. of Physics and UNAM

Prof. Hilmi Volkan Demir has been awarded The TÜBİTAK 2020 Science Award

Professor Hilmi Volkan Demir, of the Departments of Electrical and Electronics Engineering and of Physics, Chair of the Graduate Program of Materials Science and Nanotechnology (MSN) and Director of UNAM — The National Nanotechnology Research Center, has been recognized by The Scientific and Technical Research Council of Turkey (TÜBİTAK) for 2020. The prestigious TÜBİTAK Science Award of 2020, of which Dr. Demir is a winner in the field of Engineering Sciences, is the highest scientific award given by TÜBİTAK on annual basis to scientists who have made significant contributions to science at an international level.

Professor Demir received the award for his internationally recognized scientific work in the fields of semiconductor optoelectronics and nanophotonics, in particular, on the physics, optical properties and applications of quantum-confined colloidal structures for LEDs in the lighting and display technologies and for his pioneering contributions to the nanocrystal-based color conversion, display-backlighting color enrichment, energy transfer and optical gain in semiconductor nanocrystals.

UNAM PI’s have been awarded The TÜBİTAK 2020 Incentive Award

UNAM PI’s Dr. Bilge Baytekin and Dr. Ferdi Karadaş have received the TÜBİTAK 2020 Incentive Award in the field of Basic Sciences and Dr. Mustafa Serdar Önses (Erciyes University), who works within the scope of the UNAM Thousand Talents Program, has been awarded the TÜBİTAK 2020 Incentive Award in the field of Engineering Sciences.

Dr. Bilge Baytekin

Dr. Ferdi Karadaş

Dr. Mustafa Serdar Önses

Dr. Ghaith Makey

Dr. Hulusi Kafalıgönül

2020 TÜBA Academy Prizes

Within the scope of the incentive and appreciation of scientists mission of TÜBA, the TÜBA Academy Prizes, which were established on an international level are annually awarded in one of the following categories of sciences: Basic and Engineering Sciences, Health and Life Sciences and Social Sciences and Humanities. This year, Dr. Ghaith Makey, researcher at UNAM, and Dr. Hulusi Kafalıgönül, associate member at UNAM, have been awarded the Turkish Academy of Sciences 2020 Outstanding Young Scientist Award (TUBA-GEBIP).

Outstanding Achievement in Academical Awards for 2020 found their owners

UNAM PI Asst. Prof. Seymur Jahangirov, has been awarded with "The Outstanding Achievement in Academical Award" given by Bilkent University.

SEYMUR JAHANGIROV
MSN Graduate Program and UNAM

SERİM KAYACAN İLDAY
MSN Graduate Program and UNAM

Prof. Serim Ilday of Bilkent University-UNAM has been elected a fellow by the Young Academy of Europe (YAE).

The mission of the YAE, which was founded in 2012, includes providing input on scientific exchange and science policy across all member states and associated countries of the European Union. YAE members, who their peers select based on the criteria of scientific achievement and international recognition, seek to provide a "younger" perspective on the future of science policy and academia in Europe. The YAE also promotes networking among its members to create a pool of information and provide active support to colleagues across Europe.

Prof. Ilday's multi- and interdisciplinary research focuses on self-assembly, complexity, far-from-equilibrium systems, and nonlinear and stochastic dynamics. A Ph.D. graduate of Middle East Technical University, she was a postdoctoral researcher in the Department of Physics at Bilkent before joining UNAM in December 2017. She is the recipient of several awards and honors, including a European Research Council Starting Grant (2019) and a L'Oreal-UNESCO For Women in Science award (2018). Prof. Ilday's research has been published in journals including Nature Physics, Nature Photonics, Nature Communications, and Nano Letters.

Young Scientist Awards found their owners for the 8th time

Organized by the Science Heroes Association, Young Scientist Awards found their owners for the eighth time. Young Scientist Awards are held every year by the rectors of various universities to recognize the young scientists in Turkey, to encourage them and to inspire the young scientists of the future. The seven young scientists selected this year were presented their awards with a live broadcast on social media on May 18.

Dr. Çağlar Elbüken Dr. Mehmet Selim Hanay Dr. Sedat Nizamoğlu

AWARDS

Dr. Luca Biancofiore has received the 2020 METU Parlar Foundation Research Incentive Award

METU Parlar Foundation 2020 Research Incentive Award, given to young researchers who have contributed to the development of one of the fields of science with their research or helped to solve country problems in this field, was awarded to UNAM associate member Dr. Luca Biancofiore.

LUCA BIANCOFIORE
Dept. of Mechanical Engineering and UNAM

FATİH İNCİ
MSN Graduate Program and UNAM

Asst. Prof. Fatih İnci has received the JCI Ten Outstanding Young Persons of the World Turkey Award

Asst. Prof. Fatih Inci of Institute of Materials Science and Nanotechnology (UNAM) at Bilkent University has been selected as the recipient of the JCI "Ten Outstanding Young Persons of the World" (TOYP)-Turkey award in the category of "medical innovations". Each year, Junior Chamber International (JCI), one of the world's most esteemed and most active international non-profit organizations, honours "Ten Outstanding Young Persons of the World" under the age of 40, who have extraordinary accomplishments regarding business and entrepreneurship, community action, international cooperation, world peace, science, and medicine.

This year, Dr. İnci has received TOYP-Turkey Award due to his accomplishments in medical diagnostics. His research is concentrated in the emergent fields of biosensors, micro/nano-scale technology, lab-on-a-chip, and biomedical engineering. In this regard, he develops ultra-sensitive sensors and microfluidic platforms to tackle the real-world diagnostic challenges in increasingly prevalent maladies such as infectious diseases and cancer, as well as to minimize health disparities even at the resource-constraint settings.

A new Covid-19 diagnostic system has been developed at UNAM, performing with 99% accuracy in 10 seconds

A NEW COVID-19 DIAGNOSTIC SYSTEM HAS BEEN DEVELOPED AT UNAM, PERFORMING WITH 99% ACCURACY IN 10 SECONDS Within the infrastructure of Bilkent UNAM, the joint work of Dr. Bülend Ortaç and his team, Bilkent Holding and E-A Technology operating in Bilkent Cyberpark Technology Development Zone, has developed an "in vitro" virus diagnosis system that can be used to detect the new type of coronavirus (COVID-19 / SARS Cov2).

The cooperative research project, formed following the first reported COVID-19 case in Turkey and the studies of the 7 months duration gave fruitful results.

The new nanotechnology-based diagnostic system can detect the COVID-19 virus within 10 seconds with a swab taken from the mouth. It is an optically based diagnostic and identification system that changes the color of the glow in the presence of the virus, thus detecting viruses with high selectivity. In this system, pathogens are detected within 10 seconds by dynamically receiving a fluorescent signal via a pathogen detection chip developed specifically for a biosensor device. After the sample taken from the patient, it is mixed with a special solution, dropped on the pathogen detection chip, and if there is a pathogen in the environment by the biosensor device, the presence of pathogens with high accuracy is detected by taking the fluorescent signal. Taking saliva samples from the mouth instead of taking swab samples from deep areas such as the oropharynx and nasopharynx will also make the use of the system preferable. Unlike the commonly used PCR tests, the system is not based on sample replication, but on detecting the presence or absence of the virus with advanced optical methods. In the system, optical and electronic modules that provide both precise virus detection and high selectivity in detection, as well as high-level biotechnology and material science knowledge are used. The system has shown 99% success in virus detection in pre-clinical studies conducted so far. We believe that the system will be widely used in our country and in the world as a fast and reliable virus detection method. Therefore, the necessary infrastructure investments for mass production of this biosensor system have already started. The mass production phase is planned to start within an estimated 2 months, right after completing the necessary permissions from Ethics Committee Turkey Pharmaceuticals and Medical Devices Agency (TİTCK) within the shortest time. Accordingly, it will be possible to contribute to the control of the pandemic and to significantly relieve social life.

The system, is called Diagnovir, is an invention with a completely new technological infrastructure. In order to protect the intellectual rights of this innovation, the patent applications of the system have been made recently. The technology that enables the development of this successful product was developed by Turkish researchers, who have expertise in different subjects and who have carried out a very successful teamwork around a common goal, within the Bilkent UNAM infrastructure. The system has a high export potential. All marking, certification and accreditation steps that will pave the way for domestic and international sales have also started. We believe that this invention will make a tremendous impact in our country and in the world in the upcoming period.

Although the purpose of the system is to detect COVID-19 viruses, it can be used for various pathogen detection with future studies.

AWARDS

COVID-19 RESEARCH AT UNAM

At UNAM we are conducting in-depth and all-round R&D programs in the fields of nanoscience and nanotechnology to help the world recover from COVID-19 and to create benefit for humanity. Please find the latest information on our work below and stay safe.

1- DIAGNOSIS WORKS FOR COVID-19, Dr. URARTU ŞEKER, SYNTHETIC BIOSYSTEMS AND BIONANOTECHNOLOGY LABORATORY

Within the scope of the DIAGNOSIS of the factor of COVID-19, the design of two different RNA keys is being studied with the aim of developing new generation rapid tests that are fast, reliable and do not require complex systems.

2- ANTIBODY DIAGNOSTIC KITS FOR COVID-19, Dr. URARTU ŞEKER, SYNTHETIC BIOSYSTEMS AND BIONANOTECHNOLOGY LABORATORY

For antibody test kits with COVID-19 DIAGNOSTIC and PREVENTION focus, designs for the production of antigens belonging to Sars-CoV2 virus have been completed and optimization studies for the production of kits are ongoing.

3- DESIGN AND PRODUCTION OF THE PROTEIN OF SARS-COV2 BLOCKING GRFFTHIS FOR COVID-19, Dr. URARTU ŞEKER, SYNTHETIC BIOSYSTEMS AND BIONANOTECHNOLOGY LABORATORY

With the COVID-19 TREATMENT and PREVENTION focus, in this project, where we take place as TÜBİTAK COVID-19 Vaccine and Drug Development Platform Component, studies are carried out for the development of a lectin protein, named GRFT, as a drug candidate. The studies have been carrying out together with Prof. Aykut Özkul from Ankara University, Faculty of Veterinary Medicine, Department of Virology and are continuing rapidly. Devices such as SEM, AFM, Confocal microcopes, Fluorescence microscope, RT_PCR device, bioreactors, HPLC, mass spectrometry inUNAM are used in the imaging of the inactivated virus.

4- AUTONOMOUS UV-C DISINFECTION SYSTEM, Dr. HİLMİ VOLKAN DEMİR, DEMİR RESEARCH GROUP

This research, led by Dr. Hilmi Volkan Demir, with the focus of COVID-19 PREVENTION, aims to develop a highly efficient UVC LED based autonomous disinfection system for the disinfection of indoor areas where the possibility of the virus contagion is high, such as hospitals, schools and public transport.

5- DIAGNOVIR, Dr. BÜLEND ORTAÇ, ORTAÇ RESEARCH GROUP

The new nanotechnology-based diagnostic system can detect the COVID-19 virus within 10 seconds with a swab taken from the mouth. It is an optically based diagnostic and identification system that changes the color of the glow in the presence of the virus, thus detecting viruses with high selectivity. In this system, pathogens are detected within 10 seconds by dynamically receiving a fluorescent signal via a pathogen detection chip developed specifically for a biosensor device. After the sample taken from the patient, it is mixed with a special solution, dropped on the pathogen detection chip, and if there is a pathogen in the environment by the biosensor device, the presence of pathogens with high accuracy is detected by taking the fluorescent signal. Taking saliva samples from the mouth instead of taking swab samples from deep areas such as the oropharynx and nasopharynx will also make the use of the system preferable. Unlike the commonly used PCR tests, the system is not based on sample replication, but on detecting the presence or absence of the virus with advanced optical methods. In the system, optical and electronic modules that provide both precise virus detection and high selectivity in detection, as well as high-level biotechnology and material science knowledge are used. The system has shown 99% success in virus detection in pre-clinical studies conducted so far. We believe that the system will be widely used in our country and in the world as a fast and reliable virus detection method. Therefore, the necessary infrastructure investments for mass production of this biosensor system have already started. The mass production phase is planned to start within an estimated 2 months, right after completing the necessary permissions from Ethics Committee Turkey Pharmaceuticals and Medical Devices Agency (TİTCK) within the shortest time. Accordingly, it will be possible to contribute to the control of the pandemic and to significantly relieve social life.

6- DEVELOPMENT OF LASER SYSTEMS AND FIBER OPTICAL PROBES FOR MEDICAL APPLICATIONS, Dr. BÜLEND ORTAÇ, ORTAÇ RESEARCH GROUP

The treatment properties of the fiber and laser systems we developed in intravenous applications on 10000 patients have been documented. With the COVID-19 TREATMENT focus, using UV laser technology, beams are sent at certain doses and wavelengths to the regions where the disease has penetrated, while providing the patient a comfortable experience. The starting idea of the research is that cleaning process performed in the living spaces with UV rays can also be done inside the body.

7- NANOMATERIAL-BASED COLORIMETRIC AND FLUOROMETRIC APTASENSORS FOR CANCER AND INFECTIOUS DISEASES, Dr. DÖNÜŞ TUNCEL, TUNCEL RESEARCH GROUP

A study focusing on early DIAGNOSTIC for cancer and many diseases such as COVID-19.

8- PHOTODYNAMIC AND PHOTOTHERMAL THERAPIES FOR INFECTIOUS DISEASES, Dr. DÖNÜŞ TUNCEL, TUNCEL RESEARCH GROUP

This study is carried out focusing on COVID-19 TREATMENT.

9- DEVELOPMENT OF ANTIVIRAL AND ANTIBACTERIAL SURFACES, Dr. DÖNÜŞ TUNCEL, TUNCEL RESEARCH GROUP

This study is carried out focusing on COVID-19 PREVENTION.

10- INCREASING THE EFFICIENCY AND REDUCING THE SIDE EFFECTS OF KNOWN DRUGS WITH SUPRAMOLECULAR PRO-DRUG NANOPARTICULATE-BASED APPROACHES FOR VIRAL INFECTIONS AND CANCER TREATMENT, Dr. DÖNÜŞ TUNCEL, TUNCEL RESEARCH GROUP

This study is carried out focusing on COVID-19 TREATMENT.

11- PLASMONIC MODALITIES AND METAMATERIALS FOR VIRAL LOAD ANALYSIS AT THE POINT-OF-CARE SETTINGS, Dr. FATİH İNCİ

This research, led by Dr. Fatih İnci, focusing on COVID-19 DIAGNOSIS, incorporates microfluidics and metamaterial-based plasmonic sensors that can be applied in hospitals at the patient-side and directly determining the amount of the viral load. With sensitive sensors placed in channels as thin as capillaries, the presence and number of viruses are determined both precisely and specifically by looking at the color change in the light wavelength. In addition, this study has the potential to be used in TREATMENT monitoring processes.

12- FLEXIBLE CHIPS AND M-HEALTH APPROACHES FOR INFECTIOUS DISEASE DIAGNOSTICS, Dr. FATİH İNCİ

Dr. This research, led by Fatih İnci, with the focus of COVID-19 DIAGNOSIS, determines the presence of viral biomarkers via portable sensor chips, which can be applied when needed, and the data can be obtained with mobile devices such as mobile phones, and at the same time, these results can also be accessed by secure cloud platforms, Thus, the patient's DIAGNOSIS and TREATMENT can be followed up.

13- DEVELOPMENT OF A MICROWAVE-MICROFLUIDICS ENABLED PORTABLE DIAGNOSTIC PLATFORM FOR RAPID AND ACCURATE COVID-19 DETECTION AND SCREENING, Dr. GÜRKAN YEŞİLÖZ

This research program, aiming to develop a portable diagnostic platform working with microwave-microfluidic system, is being carried out with the focus on to develop a rapid, efficient and easy DIAGNOSIS and detection system for viruses or diseases, including the COVID-19 virus, under the leadership of Dr. Gürkan Yeşilöz.

UNAM Infrastructure

UNAM Main Building has been designed to provide a multidisciplinary research environment for researchers from various disciplines.

UNAM infrastructure was expanded with the addition of ARL Building (Advanced Research Lab) and high-precision manufacturing laboratory of Mechanical Engineering. Since the establishment of UNAM, the infrastructure has been sustained and improved to address the needs of researchers from academia and industry. Today UNAM houses altogether over 400 instruments.

With its ever-expanding capabilities, UNAM is being run using state-of-the-art lab management platform and coordination to support its research and development activities. As a result, UNAM has achieved over 95% up-and-running time for its core facility instruments, which can be accessed by its authorized users 24/7. Equally important, UNAM's specialized instruments can be utilized under the guidance of highly qualified UNAM technical team, if desired. New users can also be accompanied by experienced UNAM personnel to make the most of their time at UNAM facilities.

UNAM infrastructure is regularly updated to satisfy the needs of its researchers. The details of each instrument can be viewed on our facility web page: ***http://www.unam.bilkent.edu.tr/facility/***

UNAM information system, **UNAM-IS**, is used as a one-stop address to obtain access to all equipment. Users first sign up to receive their username and password on UNAM-IS. After defining their projects, they can access the listed equipment. UNAM users can also coordinate hands-on trainings on instruments and keep track of the status of each equipment on UNAM-IS.

UNAM-IS reservation procedure is hassle-free. The authorized users can monitor the availability of each instrument and make a reservation from their UNAM-IS portal.

IMAGING / MICROSCOPY

- Atomic Force Microscope (AFM, PSIA)
- Atomic Force Microscope (AFM, Asylum)
- Confocal Microscope
- Dual Beam
- E-Beam Lithography (E-BEAM)
- Environmental Scanning Electron Microscope (ESEM)
- Fluorescent and DIC Equipped Upright Microscope
- Fluorescent and DIC Equipped Inverted Microscope
- Material Microscopes
- SNOM + Raman Microscope
- Stereomicroscope
- Transmission Electron Microscope (TEM)

SPECTROSCOPY / CHROMATOGRAPHY

- Accurate-Mass Quadrupole Time-of-Flight (Q-TOF) LC/MS
- CHNS/O Elemental Analyzer
- Circular Dichroism System (CD)
- Fluorescence Spectrophotometer
- Fluorospectrometer
- FTIR Spectrometer (Tensor 37)
- FTIR Spectrometer with Microscope (Nicolet 6700)
- FTIR Spectrometer with Microscope (Vertex 70)
- FT-Raman Spectrometer
- Gas Chromatography Mass Spectrometer (GC/MS)
- Gel Permeation Chromatography (GPC)
- High Resolution Mass Time-of-Flight (TOF) LC/MS
- Inductively Coupled Plasma-Mass Spectrometer (ICP-MS)
- Microplate Reader
- Nuclear Magnetic Resonance Spectrometer (NMR)
- Preparative High Performance Liquid Chromatography
- Size Exclusion Chromatography (SEC)
- Time-resolved Fluorescence
- UV-VIS Spectrophotometer
- UV-VIS-NIR Spectrophotometer
- X-Ray Fluorescence Spectrometer (XRF)
- X-Ray Photoelectron Spectrometer (XPS)
- Peptide Synthesizer Division

CLEANROOMS

- Asher
- Atomic Layer Deposition (ALD, Fiji)
- Atomic Layer Deposition (ALD, Savannah)
- Autoclave
- Critical Point Dryer
- Dicing Saw
- Die Bonder
- E-Beam Evaporation
- Electroplating Station
- Inductively Coupled Plasma (GaN, GaAs)
- Inductively Coupled Plasma (Si)
- Low Pressure Chemical Vapor Deposition (LPCVD)
- Mask Aligner
- Mask Writer
- Optical Profilometer
- Organic Thin Film Evaporator
- Plasma Enhanced Chemical Vapor Deposition (PECVD, Plasma-Therm)
- Plasma Enhanced Chemical Vapor Deposition (PECVD, Vaksis)
- Probe Station
- Rapid Thermal Annealing (RTA)
- Scanning Electron Microscope (NanoSEM)
- Semiconductor Parameter Analyzer
- Spinners
- Sputtering Systems
- Thermal Evaporators
- Wet Benches
- Wire Bonders
- XeF_2 Etcher
- Reactive Ion Etching (RIE)
- Fine Tech Chip Bonder

UNAM Infrastructure

MATERIAL SYNTHESIS / CHARACTERIZATION

- BET Physisorption-Chemisorption
- Contact Angle Measurement System
- Differential Scanning Calorimetry (DSC, Netszch)
- Differential Scanning Calorimetry (DSC, TA)
- Dynamic Mechanical Analyzer
- Freeze Dryer System
- Isotermal Titration Calorimetry (ITC)
- Materials Research Diffractometer (MRD)
- Micromechanical Tester
- Multi-Purpose X-Ray Diffractometer
- Porosimeter
- Physical Property Measurement System (PPMS)
- Pycnometer
- Rheometer
- Thermal Gravimetric Analysis (TGA)
- Zeta Potential (Zeta Sizer)

OPTICAL / LASERS

- Carbondioxide Lasers (Coherent, Lumenis)
- Ellipsometer (IR-VASE)
- Ellipsometer (V-VASE)
- Femtosecond Laser System
- Fiber Laser (Toptica)
- Fiber Polishing Machine
- FSP Spectrum Analyzer
- He-Cd Laser (Kimmon)
- He-Ne Lasers
- High Power Lasers (custom)
- High Precision Positioning System
- Infrared Camera
- Lock-In Amplifiers
- Monochromators
- Optical Spectrum Analyzers
- Solar Simulator
- Supercontinuum Laser Source
- Tunable Diode Laser (Toptica)
- Tunable Semiconductor Laser (Santec)
- Tunable Telecommunication Laser (Newport)
- UV Lasers
- Xe, Halogen, Deuterium Light Sources

HIGH PRECISION MANUFACTURING

- 5 Axis Machine Nanotech FG 350
- SODICK-Wire EDM
- Zeiss MICURA CMM
- Keyence Microscope
- Zwick Microsurgery Equipment
- 3D Printer Markerbot and Replicator

UNAM Infrastructure

FIBER PRODUCTION / CHARACTERIZATION

- Fiber Draw Tower
- Fiber Draw Tower (high temperature up to 2,300 °C)
- Glass Production System
- Infrared Camera
- Modified Chemical Vapor Deposition (MCVD)
- Preform Analyzer
- Preform Consolidator
- Preform Polariscope
- Preform Slice Measurement System
- Preform Washer
- Quartz Cutting Saw
- Rocking Furnace
- Scrubber
- Thermal Evaporation System
- Three-zone Furnace (1,200 °C)
- Vacuum Ovens

SAMPLE PREPARATION

- Cut-off and Grinding Machine
- Dimple Grinder
- Disc Grinder
- Disc Punch
- Electrolytical Thinner
- Glass KnifeMaker
- Grinding and Polishing Machines
- Mounting Press
- Precision Etching Coating System (PECS)
- Precision Ion Polishing System (PIPS)
- Ultramicrotome
- Ultrasonic Cutter
- Vacuum Impregnation

BIOTECHNOLOGY

- Bioreactors (2 L / 5 L / 30 L)
- Centrigures / Microfuges / Ultracentrifuges
- Cold Room
- Cryostat
- Electroporator
- -80°C Freezers
- Gel Imaging and Documentation System
- Gradient PCR
- Gradient Real-Time PCR
- Laminar Flow Cabinets
- Microplate Reader
- Microtomes
- Osmometer
- Shaking Incubators
- Sterile Cabins
- Vibratome

NATIONAL NANOTECHNOLOGY RESEARCH CENTER

INSTITUTE OF MATERIALS SCIENCE AND NANOTECHNOLOGY

Metal and Dielectric Evaporation

There are various evaporation methods we use at UNAM to deposit nanometer thick coatings of metals and dielectrics on surfaces. A user monitors the chamber of the electron beam evaporator at UNAM in the picture

UNAM Spin-offs

As being the first and only national nanotechnology lab of Turkey, UNAM is actively engaged in technologies that have high market value. The technological leaps discovered by UNAM researchers have been the seed for several UNAM spin-off companies.

The companies benefit from the close proximity of incubation centers such as Bilkent Cyberpark, METU Technopolis and Hacettepe Technopolis which provide them with the collaborative ecosystem to expedite the product realization cycle. Our spin-offs have benefited an additional boost with the establishment of Bilkent University Technology Transfer Office. Some of UNAM spin-off companies include:

- Auron Teknoloji
- Biyonesil
- CSY
- Deber
- E-A Teknoloji
- Felisya Biyoteknoloji
- Hilite
- Innovative In Vivo Sensing
- İnnovel
- İnovnano
- IPS
- LST Scientific Instruments
- MRid
- Nanobiyoteknoloji
- Nanodev
- NanoEye
- Nanome
- Nanosens
- Niser Yazı
- Sensonance
- SY Nanoboyatek
- Synbiotik
- Yeni Bilge Nanoteknoloji

E-A Teknoloji

E-A Teknoloji Ltd. is an UNAM spin-off company established in 2010. E-A Teknoloji enjoys its success in producing and marketing medical optical fibers for endovenous laser operations. Optical fibers have long been used in treatment of varicose veins, which were produced in European countries. After several years of R&D, an essential part of which took place at UNAM laboratories, now the know-how of medical optical fiber production for endovenous applications is accomplished. Among different types of optical fibers used in laser applications, especially radial emitters, of which output is in the shape of a homogenous ring towards the circumference of the fiber, are frequently used by the medical practitioners for their enhanced efficiency in the treatment.

The radial fibers developed by E-A Teknoloji have passed all the tests necessary for the field use. Currently the serial production and marketing of these “Made in Turkey” radial fibers have been initiated, which is a huge leap for the company from doing solely R&D, towards large-scale manufacturing. The very first feedbacks from the medical doctors that used these fibers are very motivating because they have better efficiency and durability compared to their available products in the market. Yet, the scope of the company is not limited neither to endovenous applications nor radial fibers, continuing research on other types of optical fibers, which would find applications in various fields such as urology, gynecology, ENT operations, ophthalmology and other minimally invasive and non-invasive laser applications.

Nanodev Scientific

Nanodev Scientific is a spin-off company that manufactures advanced optical and biomedical characterization devices. Nanodev has revenue on a wide range of high-tech products including surface plasmon resonance systems, biomedical detection systems and advanced microscopes. Currently, Nanodev Scientific devices are being used at leading institutions worldwide. Novel projects of Nanodev were awarded several times including “Most-Promising Start-up”, “Novel Biomedical Device” and “1st prize in R&D Contest”. Main goal of Nanodev is to apply their cutting-edge technology into daily life.

The most promising project of Nanodev is a device that makes it possible to detect a series of diseases at home. Imagine being able to touch a small device and instantly get back whether you have key indicators for a heart attack or an infectious disease. Such early detection tools are some of the innovative products that Nanodev is developing.

UNAM Patents

PATENT NUMBER	APPLICATION DATE	PUBLICATION DATE DATE OF ISSUE	TITLE	INTERNATIONAL PATENT FAMILY
EP17791682	10/30/2017	7/8/2020	Inductive Coil Unit Comprising Conductive Layers	EP
2015/07405	6/17/2015	5/21/2020	Ortam Koşullarında Yapısal Kayganlık Sergileyen Mikrometre-Altı Ölçekli Ara Yüzlere Sahip Malzeme Sistemi ve Bu Malzeme Sisteminin Sentezine İlişkin Yöntem	TR
CN20168053426	9/19/2016	7/17/2020	Extraction Structure For A Uv Lamp	CN
US201615759727	9/19/2016	11/17/2020	Extraction Structure for A UV Lamp	US
2015/16654	12/22/2015	21.1.2020	Geleneksel Dörtlü Sarım Makinesinde Sekizli Sarım Deseni Elde Etmek İçin Geliştirilen Bir Aparat	TR
2015/16381	12/18/2015	6/22/2020	Bir Nikel-Krom (Ni-Cr) İnce Film Direnç Üretim Yöntemi	TR
2014/09373	8/12/2014	8/21/2020	Bir Hidrojen Siyanür (Hcn) Sensörü ve Bunu Elde Etme Yöntemi.	TR
2017/14499	9/28/2017	6/22/2020	Sensörler İçin Bir Mikro Isıtıcı Taban ve Bunun Üretim Yöntemi	TR
2017/17381	11/6/2017	7/21/2020	Bir Fiber Optik Dağıtık Akustik Sensör Aygıtı	TR
US201816486860	2/8/2018	28.7.2020	A Chip Testing Method And An Apparatus For Testing Of A Plurality Of Field Emission Light Sources	US
US201916262305	1/30/2019	5.5.2020	Displacement And Deformation Monitoring Method And System Without Using Any Strain Sensor, And Components Thereof	US
US201816625931	12/23/2019	4.8.2020	A Field Emission Cathode Structure For A Field Emission Arrangement	US
US201916363074	25/03/2019	9.6.2020	High Performance Sealed-Gap Capacitive Microphone	US
2016/20009	12/29/2016	21.7.2020	Bir Ingaas/Inp Kızılötesi Fotodedektör Odak Düzlem Dizini (Odd) Yapısı ve Bunun Fabrikasyon Yöntemi	TR
EP20180158239	2/22/2018	12/2/2020	Display Device	EP
US201916281386	2/21/2019	3/10/2020	Display Device	US
2017/13717	9/15/2017	12/21/2020	Grafen Tabanlı Çoklu Kuantum Kuyu İçeren Bir Yarıiletken Yapı ve Bunu Büyütme Yöntemi	TR
2016/05127	4/20/2016	11/23/2020	Atomik Kuvvet Mikroskobu için Sonda	TR
CN20158061473	9/5/2015	9/8/2020	Cartridge Device With Segmented Fluidics For Assaying Coagulation In Fluid Samples	CN
EP20160804930	10/24/2016	11/4/2020	A Cable System with Sensor	EP
US201815862182	1/4/2018	11/3/2020	Photoluminescent Polarizers and Electronic Devices Including the Same	US
US201916241164	1/7/2019	8/25/2020	High Performance Sealed Gap Capacitive Microphone with Various Gap Geometries	US
PCT/TR2020/051272	12/11/2020		Bir Isı İzolasyon Bariyeri ve Bunu İçeren Bir Sıvı Kristal Ekran	PCT
PCT/TR2020/051273	12/11/2020		Kılıf Işın Sıyırıcı ve Üretim Yöntemi	PCT
PCT/TR2020/051352	12/22/2020		Bir Dönüştürme Aparatı ve Bunu İçeren Bir Ekran	PCT
PCT/TR2020/051353	12/22/2020		Bir Optik İzolasyon Yöntemi	PCT
PCT/TR2020/051415	12/28/2020		Bir Tıbbi Teşhis Cihazı	PCT
PCT/TR2020/051416	12/28/2020		Ekranların Renk Zenginliğini Artırmayı Sağlayan Bir Yöntem	PCT
62/980,595	3/18/2020		Plastic-Template Metasurfaces For Multi-Modal And Multiplex Biosensing	US
63/045,495	5/28/2020		Entangled Nano-Plasmonic Cavities For Estimating Thickness Of Surface Adsorbed Layers/ Optical Method For Measuring Thickness of Surface-Adsorbed Layers With Nanometric Length-Scale	US

UNAM Patents

PATENT NUMBER	APPLICATION DATE	PUBLICATION DATE DATE OF ISSUE	TITLE	INTERNATIONAL PATENT FAMILY
62989919	3/16/2020		Observation Of Flow-Induced Instability of a Nano-Membrane And Its Use For On-Chip Flow Rate Sensing	US
63007958	4/10/2020		Device For Obtaining The Mass Of Single Nanoparticles, Viruses And Proteins In Suspension Or In Solution With High-Collection Efficiency	US
63055917	7/24/2020		Device For Obtaining The Mass Of Single Nanoparticles, Viruses And Proteins In Suspension Or In Solution With High-Collection Efficiency	US
2020/00238	1/8/2020		Çok katmanlı hologramlarda katmanlar arası girişimin azaltılmasına yönelik yöntem	TR
2020/04873	27/03/2020		Proton Değişimi Yöntemi İçin Bir Asansörlü Düzenek	TR
2020/06104	17/04/2020		Nanoparçacık Formunda Bir Dielektrik Tabaka İçeren Bir Yarıiletken Aygıt Yapısı ve Bunu Elde Etme Yöntemi	TR
2020/07638	15/05/2020		Gan Temelli Yüksek Elektron Mobiliteli Transistör (Yemt) Aygıtı İçin Bir Kapı Kontağı Fabrikasyon Yöntemi	TR
2020/07990	22/05/2020		Seçici Maskeleme İle Kuru Aşındırma Yöntemi	TR
2020/08105	27/05/2020		Çoklu Kuatum Kuyu İçeren Bir Yüksek Elektron Mobiliteli Transistor Aygıtı ve Bunun Üretim Yöntemi	TR
2020/09096	12/06/2020		Dairesel Alttaş İçin Bir Dönel Kenar Yığını Alma Aparatı	TR
2020/09098	12/06/2020		Yüksek Elektron Mobiliteli Transistör (Yemt) Aygıtı ve Bunun Üretim Yöntemi	TR
2020/10167	29/06/2020		Dalga Kılavuzu Üretimi İçin Bir Tavlanmış Proton Değişimi Yöntemi	TR
2020/10170	29/06/2020		Çevresel Etmenlere Dayanıklı Bir Dalga Kılavuzu Tipi Kutuplayıcı Üretim Yöntemi	TR
2020/10321	30/06/2020		Bir Tavlanmamış Ohmik Kontak Oluşturma Yöntemi	TR
2020/10325	30/06/2020		Şeffaf Metal Pencere İçeren İndiyum Galyum Nitrat (Ingan) Temelli Güneş Hücresi Fabrikasyon Yöntemi	TR
2020/10982	10/07/2020		Fiber Optik Sarım İçin Bir Makara	TR
2020/11978	28/07/2020		Derin Ultraviyole Bölgesinde Yüksek Işıma Şiddetine Sahip Bir Işık Yayan Diyot Yarıiletken Yapısı ve Aygıtı	TR
2020/14952	21/09/2020		Bir Elektriksel İzolasyon Bölgesi Oluşturma Yöntemi	TR
2020/18191	13/11/2020		Isı Transferi Yüksek Bir Yüksek Elektron Mobiliteli Transistör Aygıtı ve Bunu Elde Etme Yöntemi	TR
2020/18647	20/11/2020		Elektronik Ayarlanabilir Optik Zayıflatıcı İçeren Bir Fiber Optik Dağıtık Akustik Sensör Aygıtı	TR
2020/18648	20/11/2020		Yüksek Elektron Mobiliteli Transistör (Yemt) Epitaksiyel Yapısı ve Bunu Büyütme Yöntemi	TR
2020/19891	7/12/2020		Fiber Optik Sarım İçin Bir Yapıştırıcı Bileşimi	TR
2020/21576	24/12/2020		Optik Fiber İçin Bir Yapıştırıcı Uygulama Aparatı	TR
2020/21883	28/12/2020		Bir Yapıştırıcı Uygulama Aparatı	TR
2020/22357	30/12/2020		Bir İnce Film Direnç Elemanı Oluşturma Yöntemi	TR
2020/22535	30/12/2020		Bir Sarım Makarası	TR
2020/21833	12/26/2020		Tek Kullanımlık Patojen Tespit Çipi ve Buna İlişkin Bir Üretim Metodu	TR
PCT/TR2020/051423	12/28/2020		Tek Kullanımlık Patojen Tespit Çipi ve Buna İlişkin Bir Üretim Metodu	PCT
2020/21834	12/26/2020		Fret Tekniği için Özelleştirilmiş Bir Biyosensör Cihazı ve Patojen Tespit Yöntemi	TR
PCT/TR2020/051424	12/28/2020		Fret Tekniği için Özelleştirilmiş Bir Biyosensör Cihazı ve Patojen Tespit Yöntemi	PCT

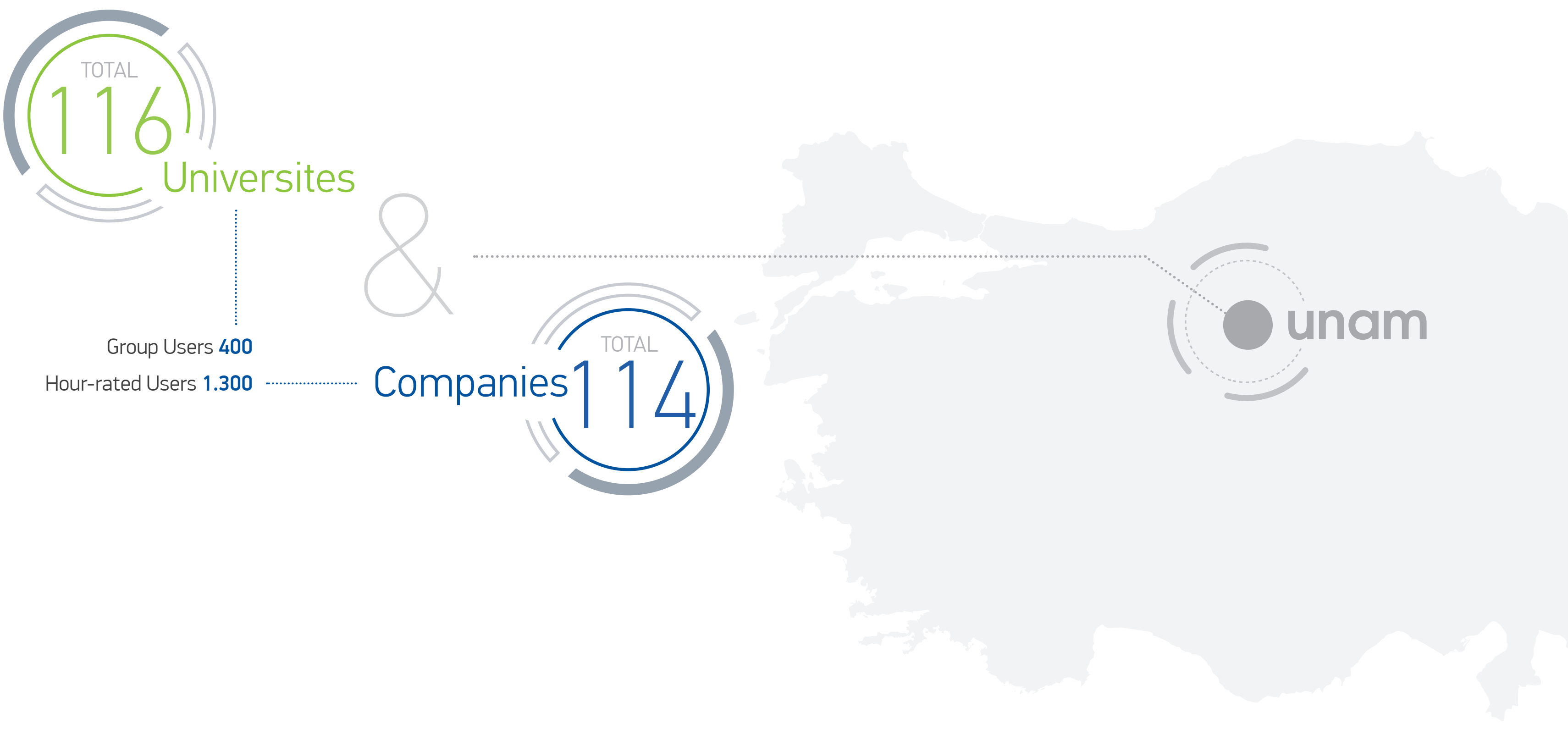
UNAM Users across Turkey

Are you after a challenging research problem? Do you need help in performing experimental measurements using state-of-the-art equipment? Then, UNAM is the place for you.

Since its establishment, UNAM has been serving many hundreds of researchers from various disciplines. We believe sharing the expertise we have is the key to leapfrog revolutionary technologies. We place utmost priority in keeping the infrastructure functional for the use of all our users.

UNAM is accessible to all researchers. Currently there are more than 1,700 users of UNAM. Being located in Ankara, UNAM is accessible to all researchers across Turkey. The number of universities that are utilizing UNAM has reached 116 and the number of companies using UNAM is now 114. We receive very positive feedback from all UNAM users and this motivates us further in extending our facility and serving the whole community more effectively.

At UNAM, our users are fully engaged in all the steps of the service UNAM provides. It is not only the infrastructure, but also our expertise we share that help users make the most out of their experience at UNAM. We continuously strive to improve our technical capability and operation procedures to maximize the output of all UNAM users.



UNAM Users from Academia

Abdullah Gül Üniversitesi, Kayseri
Acıbadem Üniversitesi, İstanbul
Adana Bilim Üniversitesi, Adana
Afyon Kocatepe Üniversitesi, Afyon
Akdeniz Üniversitesi, Antalya
Aksaray Üniversitesi, Aksaray
Alanya Alaaddin Keykubat Üniversitesi
Amasya Üniversitesi, Amasya
Anadolu Üniversitesi, Eskişehir
Ankara Hacıbayramı Veli Üniversitesi, Ankara
Ankara Üniversitesi, Ankara
Antalya Bilim Üniversitesi, Antalya
Ardahan Üniversitesi, Ardahan
Atatürk Üniversitesi, Erzurum
Atılım Üniversitesi, Ankara
Aydın Adnan Menderes Üniversitesi, Aydın
Balıkesir Üniversitesi, Balıkesir
Bartın Üniversitesi, Bartın
Başkent Üniversitesi, Ankara
Beykent Üniversitesi
Beykent Üniversitesi, İstanbul
Bilecik Şeyh Edebali Üniversitesi, Bilecik
Bingöl Üniversitesi, Bingöl
Boğaziçi Üniversitesi, İstanbul
Bolu Abant İzzet Baysal Üniversitesi, Bolu
Burdur Mehmet Akif Ersoy Üniversitesi, Burdur
Bursa Uludağ Üniversitesi, Bursa
Bursa Teknik Üniversitesi, Bursa
Çankaya Üniversitesi, Ankara
Çankırı Karatekin Üniversitesi, Çankırı
Çukurova Üniversitesi, Adana
Dicle Üniversitesi, Diyarbakır
Doğu Akdeniz Üniversitesi, KKTC
Dokuz Eylül Üniversitesi, İzmir
Düzce Üniversitesi, Düzce
Ege Üniversitesi, İzmir
Erciyes Üniversitesi, Kayseri
Erzincan Binali Yıldırım Üniversitesi, Erzincan
Erzurum Teknik Üniversitesi, Erzurum
Eskişehir Teknik Üniversitesi, Eskişehir
Fırat Üniversitesi, Elazığ
Gazi Üniversitesi, Ankara
Gaziantep Üniversitesi, Gaziantep
Gebze Teknik Üniversitesi, Kocaeli
Giresun Üniversitesi, Giresun
Gümüşhane Üniversitesi, Gümüşhane
Hacettepe Üniversitesi, Ankara
Hakkari Üniversitesi, Hakkari
Harran Üniversitesi, Şanlıurfa
Hatay Mustafa Kemal Üniversitesi, Hatay
Hitit Üniversitesi, Çorum
İhsan Doğramacı Bilkent Üniversitesi, Ankara
İnönü Üniversitesi, Malatya
Isparta Uygulamalı Bilimler Üniversitesi, Isparta
İstanbul Sebahattin Zaim Üniversitesi, İstanbul
İstanbul Medeniyet Üniversitesi, İstanbul
İstanbul Teknik Üniversitesi, İstanbul
İstanbul Üniversitesi Cerrahpasa, İstanbul
İstanbul Üniversitesi, İstanbul
İzmir Yüksek Teknoloji, İzmir
İzmir Katip Çelebi Üniversitesi, İzmir
Kadir Has Üniversitesi, İstanbul
Kafkas Üniversitesi, Kars
Kahramanmaraş Sütçü İmam Üniversitesi
Karabük Üniversitesi, Karabük
Karadeniz Teknik Üniversitesi, Trabzon
Karamanoğlu Mehmet Bey Üniversitesi, Karaman
Kastamonu Üniversitesi, Kastamonu
Kırıkkale Üniversitesi, Kırıkkale
Kırşehir Ahi Evran Üniversitesi, Kırşehir
Koç Üniversitesi, İstanbul
Kocaeli Üniversitesi, Kocaeli
Konya Gıda ve Tarım Üniversitesi, Konya
Konya Teknik Üniversitesi, Konya
KTO Karatay Üniversitesi, Konya
Kütahya Dumlupınar Üniversitesi, Kütahya
Malatya Turgut Özal Üniversitesi, Malatya
Maltepe Üniversitesi, İstanbul
Manisa Celal Bayar Üniversitesi, Manisa
Marmara Üniversitesi, İstanbul
Mersin Üniversitesi, Mersin
Milli Savunma Üniversitesi, İstanbul
Muğla Sıtkı Koçman Üniversitesi, Muğla
Necmettin Erbakan Üniversitesi, Konya
Nevşehir Hacı Bektaş Veli Üniversitesi, Nevşehir
Niğde Ömer Halisdemir Üniversitesi, Niğde
Nişantaşı Üniversitesi, İstanbul
Ondokuz Mayıs Üniversitesi, Samsun
Ordu Üniversitesi, Ordu
Orta Doğu Teknik Üniversitesi (OTTÜ), Ankara
Osmangazi Üniversitesi, Eskişehir
Osmaniye Korkut Ata Üniversitesi, Osmaniye
Pamukkale Üniversitesi, Pamukkale
Recep Tayyip Erdoğan Üniversitesi, Rize
Sabancı Üniversitesi, İstanbul
Sağlık Bilimleri Üniversitesi, İstanbul
Sakarya Üniversitesi, Sakarya
Selçuk Üniversitesi, Konya
Sivas Cumhuriyet Üniversitesi, Sivas
Süleyman Demirel Üniversitesi, Isparta
Tarsus Üniversitesi, Mersin
TED Üniversitesi
Tekirdağ Namık Kemal Üniversitesi, Tekirdağ
TOBB ETÜ Ekomomi ve Teknoloji Üniversitesi, Ankara
Tokat Gaziosmanpaşa Üniversitesi, Tokat
Trakya Üniversitesi, Edirne
Türk Hava Kurumu Üniversitesi, Ankara
Yakın Doğu Üniversitesi, KKTC
Yalova Üniversitesi, Yalova
Yaşar Üniversitesi, İzmir
Yeditepe Üniversitesi, İstanbul
Yıldırım Beyazıt Üniversitesi, Ankara
Yıldız Teknik Üniversitesi, İstanbul
Yozgat Bozok Üniversitesi, Yozgat
Yüzüncüyıl Üniversitesi, Van
Zonguldak Bülent Ecevit Üniversitesi, Zonguldak

UNAM Users from Industry

Some of the companies utilizing UNAM infrastructure include:

- AB-MIKRONANO
- AGAMİRZE
- AKZO NOBEL BOYA
- ARÇELİK
- ARGETEST
- ARITEKS
- ART BANT
- ARTRON
- ARVEN
- AS İNŞAAT
- ASELSAN
- ASPİLSAN A.Ş.
- ASSAN GIDA
- ATAKİM BOYA
- BAYRAK AR-GE
- BAYTEK KESİCİ TAKIMLAR
- BENDİS TOPRAK
- BEREN ECZA DEPOSU
- BETOPAN
- BİYOTEZ
- BOSCH SIEMENS
- BOYLAM YAZILIM
- BRK MEDİKAL
- CANNES
- CREON
- CYBERPARK
- Delta V UZAY TEKNOLOJİLERİ
- DELTAMED
- DESU MEDİKAL
- DIGITEST SAV.
- DİZAYN GRUP
- DROGSAN ECZACILIK
- DS ÜRÜN TAKİP
- DST MEDİKAL
- DYO
- E-A TEKNOLOJİ
- E-BERK MAKİNA
- ECZACIBAŞI
- EMBİL İLAÇ
- ENİGMA
- ERMEKSAN
- ERYİĞİT TIBBİ CİHAZLAR
- ETİ MADEN
- FİGES A.Ş.
- FOTONİKA
- GATA
- GENAMAR AR-GE
- GENZ BİYOTEKNOLOJİ
- GO ENERJİ
- GODİ BİYOTEKNOLOJİ
- HAYAT KİMUA
- HEMOSOFT BİLİŞİM
- İBA VALSERA
- İKSA LTD.
- İNOVAKTİF
- İŞBİR SENTETİK
- İSKO-SANKO
- İSTEM MEDİKAL
- KAF GRUP
- KORDSA
- KORDSA TEKSTİL
- KOROZO
- LİNAKOL MEDİKAL
- MACPHARMA
- MAGİÇE - MAGNETİK TEKNOLOJİLERİ
- MAN
- MEDHOM
- METEKSAN
- MİKRO BİYOSİSTEMLER
- MİKRON MAKİNA
- MİKROSİSTEMLER
- MİT
- MONO KRİSTAL TEKNOLOJİLERİ
- MS SPEKTRAL SAVUNMA SANAYİİ
- MTA
- NANODEV
- NANOGRAFİ
- NANOMANYETİK BİLİMSEL CİHAZLAR
- NANOME
- NERO ENDÜSTRİ
- NORMMED MEDİKAL
- NUROL
- OL MÜHENDİSLİK VE OTOMASYON
- ÖZTEK TEKSTİL
- ÖZTÜRK YARI İLETKEN TEKNOLOJİLERİ
- PAŞABAHÇE
- PLASBANT PALSTİK
- PMS MEDİKAL
- RAMADA
- ROKETSAN
- SASAN MEDİKAL
- SENSES
- SERMED TIBBİ CİHAZLAR
- ŞİŞECAM
- SİSTEM ALUMİNYUM SANAYİ
- SO SOĞUTMA
- SPM A.Ş
- STC ELEKTRONİK
- TDU SAVUNMA SUN TESKTİL
- TEKSER
- TR-TEST
- TÜBİTAK MAM
- TÜBİTAK SAGE
- TUBİTAK UZAY
- TÜPRAŞ
- TÜRKİYE PETROLLERİ
- TURPAMED
- TUSAS
- ULUDAĞ İÇECEK
- ULUSOY MEDİKAL
- VAKSİS
- VAMED MEDİKAL
- VESTEL
- VİROSENS MEDİKAL

Partnerships with Industry

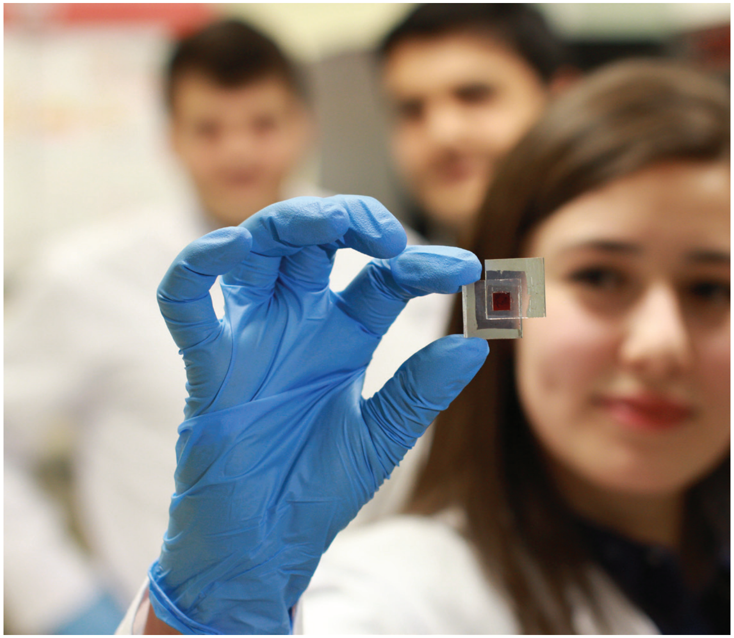
UNAM serves the whole country with its infrastructure; in 2020, the number of the companies using UNAM infrastructure has reached 114. The total number of external users has exceeded 1,700. Since UNAM is used by researchers with a wide range of interests, it creates an effective ecosystem for other researchers to network with each other.

UNAM offers an environment that promotes industry and academy partnership. Researchers at UNAM conduct interdisciplinary projects and meet the expectations of industry stakeholders. UNAM aims to increase the scientific and technological capacities of SMEs and large institutions by carrying out joint and industry contracted projects. Besides, UNAM's infrastructure provides companies with access to state-of-the-art equipment and the technical know-how required for their specific needs.

In addition to providing industrial companies with infrastructure support, UNAM also conducts research projects with companies. Currently, various research projects are funded by industrial companies at UNAM. Beyond working one-to-one with the companies, cooperation meetings are also organized within the scope of high-tech platform to bring together a large number of companies and research centers.

Together with the Turkish Aerospace Industry (TUSAŞ), our application to TÜBİTAK 2244 Industry Doctoral Program has been accepted. Doctoral students who will be supported within the scope of the project will have the opportunity to work at TUSAŞ after completing their PhD studies at UNAM.

UNAM signs protocols with the companies that wish to carry out R&D at UNAM. With the application of "CorporateLab@UNAM" which is implemented with these protocols, companies can take part at UNAM as an enterprise. As the first examples, "TUSAŞ@UNAM", "Vestel@UNAM" and "Şişecam@UNAM" protocols were signed. Some other big companies have expressed their desire to take part at UNAM in the same program. UNAM has thus far also signed protocols with ASELSAN, Cannes Biotechnology and GenZ Biotechnology for training and infrastructure use.



COVID-19 TESTS & PCR TEST KITS

UNAM has managed to remain open 24/7 throughout the COVID-19 pandemic.

UNAM, with the authorization from the **Ministry of Health,** performs regular official PCR tests to those who use the infrastructure and which the test results are uploaded to e-Nabız every week.

Voliron® RT-PCR Kit for SARS-CoV-2 virus: The test kits that have been approved by HSGM are used.

To the best of our knowledge, this application is unique in Turkey.

Nature Index/High-Impact Publications

1. Ahmed, R., Ozen, M. O., Karaaslan, M. G., Prator, C. A., Thanh, C., Kumar, S., Torres, L., Iyer, N., Munter, S., Southern, S., Henrich, T. J., Inci, F., and Demirci, U. (2020) Tunable Fano-Resonant Metasurfaces on a Disposable Plastic-Template for Multimodal and Multiplex Biosensing, Advanced Materials 32.

2. Altintas, Y., Liu, B. Q., Hernandez-Martinez, P. L., Gheshlaghi, N., Shabani, F., Sharma, M., Wang, L., Sun, H. D., Mutlugun, E., and Demir, H. V. (2020) Spectrally Wide-Range-Tunable, Efficient, and Bright Colloidal Light-Emitting Diodes of Quasi-2D Nanoplatelets Enabled by Engineered Alloyed Heterostructures, Chemistry of Materials 32, 7874-7883.

3. Alù, A., Demir, H. V., and Jagadish, C. (2020) Active Nanophotonics, Proceedings of the IEEE 108, 625-627.

4. Ayan, S., Gunaydin, G., Yesilgul-Mehmetcik, N., Gedik, M. E., Seven, O., and Akkaya, E. U. (2020) Proof-of-principle for two-stage photodynamic therapy: hypoxia triggered release of singlet oxygen, Chemical Communications 56, 14793-14796.

5. Bruce, E. E., Okur, H. I., Stegmaier, S., Drexler, C. I., Rogers, B. A., van der Vegt, N. F. A., Roke, S., and Cremer, P. S. (2020) Molecular Mechanism for the Interactions of Hofmeister Cations with Macromolecules in Aqueous Solution, Journal of the American Chemical Society 142, 19094-19100.

6. Caglayan, M., Irfan, M., Ercan, K. E., Kocak, Y., and Ozensoy, E. (2020) Enhancement of photocatalytic NOx abatement on titania via additional metal oxide NOx-storage domains: Interplay between surface acidity, specific surface area, and humidity, Applied Catalysis B-Environmental 263.

7. Demirci, S., Rad, S. E., Kazak, S., Nezir, S., and Jahangirov, S. (2020) Monolayer diboron dinitride: Direct band-gap semiconductor with high absorption in the visible range, Physical Review B 101.

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9. Erbil, S. O., Hatipoglu, U., Yanik, C., Ghavami, M., Ari, A. B., Yuksel, M., and Hanay, M. S. (2020) Full Electrostatic Control of Nanomechanical Buckling, Physical Review Letters 124

10. Erdem, O., Foroutan, S., Gheshlaghi, N., Guzelturk, B., Altintas, Y., and Demir, H. V. (2020) Thickness-Tunable Self-Assembled Colloidal Nanoplatelet Films Enable Ultrathin Optical Gain Media, Nano Letters 20, 6459-6465.

11. Foroutan-Barenji, S., Erdem, O., Gheshlaghi, N., Altintas, Y., and Demir, H. V. (2020) Optical Gain in Ultrathin Self-Assembled Bi-Layers of Colloidal Quantum Wells Enabled by the Mode Confinement in their High-Index Dielectric Waveguides, Small 16.

12. Ghobadi, T. G. U., Ghobadi, A., Buyuktemiz, M., Yildiz, E. A., Yildiz, D. B., Yaglioglu, H. G., Dede, Y., Ozbay, E., and Karadas, F. (2020) A Robust, Precious-Metal-Free Dye-Sensitized Photoanode for Water Oxidation: A Nanosecond-Long Excited State Lifetime through a Prussian Blue Analogue, Angewandte Chemie-International Edition 59, 4082-4090.

13. Hu, Z. H., Hernandez-Martinez, P. L., Liu, X., Amara, M. R., Zhao, W. J., Watanabe, K., Taniguchi, T., Demir, H. V., and Xiong, Q. H. (2020) Trion-Mediated Forster Resonance Energy Transfer and Optical Gating Effect in WS2/hBN/MoSe2 Heterojunction, ACS Nano 14, 13470-13477.

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15. Kani, K., Henzie, J., Dag, O., Wood, K., Iqbal, M., Lim, H., Jiang, B., Salomon, C., Rowan, A. E., Hossain, M. S. A., Na, J., and Yamauchi, Y. (2020) Electrochemical Synthesis of Mesoporous Architectured Ru Films Using Supramolecular Templates, Small 16.

16. Khaidarov, E., Liu, Z. T., Paniagua-Dominguez, R., Ha, S. T., Valuckas, V., Liang, X. N., Akimov, Y., Bai, P., Png, C. E., Demir, H. V., and Kuznetsov, A. I. (2020) Control of LED Emission with Functional Dielectric Metasurfaces, Laser & Photonics Reviews 14.

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18. Liu, B. Q., Altintas, Y., Wang, L., Shendre, S., Sharma, M., Sun, H. D., Mutlugun, E., and Demir, H. V. (2020) Record High External Quantum Efficiency of 19.2% Achieved in Light-Emitting Diodes of Colloidal Quantum Wells Enabled by Hot-Injection Shell Growth, Advanced Materials 32.

19. Makey, G., Galioglu, S., Ghaffaril, R., Engin, E. D., Yildirim, G., Yavuz, O., Bektas, O., Nizam, U. S., Akbulut, O., Sahin, O., Gungor, K., Dede, D., Demir, H. V., Ilday, F. O., and Ilday, S. (2020) Universality of dissipative self-assembly from quantum dots to human cells, Nature Physics 16, 795-+.

20. Morsali, M., Khan, M. T. A., Ashirov, R., Hollo, G., Baytekin, H. T., Lagzi, I., and Baytekin, B. (2020) Mechanical Control of Periodic Precipitation in Stretchable Gels to Retrieve Information on Elastic Deformation and for the Complex Patterning of Matter, Advanced Materials 32.

21. Mylnikov, V., Ha, S. T., Pan, Z. Y., Valuckas, V., Paniagua-Dominguez, R., Demir, H. V., and Kuznetsov, A. I. (2020) Lasing Action in Single Subwavelength Particles Supporting Supercavity Modes, ACS Nano 14, 7338-7346.

Nature Index/High-Impact Publications

22. Onat, O. E., Kars, M. E., Gul, S., Bilguvar, K., Wu, Y. M., Ozhan, A., Aydin, C., Basak, A. N., Trusso, M. A., Goracci, A., Fallerini, C., Renieri, A., Casanova, J. L., Itan, Y., Atbasoglu, C. E., Saka, M. C., Kavakli, I. H., and Ozcelik, T. (2020) Human CRY1 variants associate with attention deficit/hyperactivity disorder, Journal of Clinical Investigation 130, 3885-3900.

23. Özel, M., Demir, F., Aikebaier, A., Kwiczak-Yiğitbaşı, J., Baytekin, H. T., and Baytekin, B. (2020) Why Does Wood Not Get Contact Charged? Lignin as an Antistatic Additive for Common Polymers, Chemistry of Materials 32, 7438-7444.

24. Pekdemir, S., Torun, I., Sakir, M., Ruzi, M., Rogers, J. A., and Onses, M. S. (2020) Chemical Funneling of Colloidal Gold Nanoparticles on Printed Arrays of End-Grafted Polymers for Plasmonic Applications, ACS Nano 14, 8276-8286.

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26. Serhatlioglu, M., Isiksacan, Z., Ozkan, M., Tuncel, D., and Elbuken, C. (2020) Electro-Viscoelastic Migration under Simultaneously Applied Microfluidic Pressure-Driven Flow and Electric Field, Analytical Chemistry 92, 6932-6940.

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28. Shornikova, E. V., Yakovlev, D. R., Tolmachev, D. O., Ivanov, V. Y., Kalitukha, I. V., Sapega, V. F., Kudlacik, D., Kusrayev, Y. G., Golovatenko, A. A., Shendre, S., Delikanli, S., Demir, H. V., and Bayer, M. (2020) Magneto-Optics of Excitons Interacting with Magnetic Ions in CdSe/CdMnS Colloidal Nanoplatelets, ACS Nano 14, 9032-9041.

29. Taghipour, N., Delikanli, S., Shendre, S., Sak, M., Li, M. J., Isik, F., Tanriover, I., Guzelturk, B., Sum, T. C., and Demir, H. V. (2020) Sub-single exciton optical gain threshold in colloidal semiconductor quantum wells with gradient alloy shelling, Nature Communications 11.

30. Wu, M. F., Ha, S. T., Shendre, S., Durmusoglu, E. G., Koh, W. K., Abujetas, D. R., Sanchez-Gil, J. A., Paniagua-Dominguez, R., Demir, H. V., and Kuznetsov, A. I. (2020) Room-Temperature Lasing in Colloidal Nanoplatelets via Mie-Resonant Bound States in the Continuum, Nano Letters 20, 6005-6011.

31. Yu, J. H., Sharma, M., Sharma, A., Delikanli, S., Demir, H. V., and Dang, C. (2020) All-optical control of exciton flow in a colloidal quantum well complex, Light-Science & Applications 9.

High-Impact Papers in 2020 **31**

Journal publications with impact factor of 10 or above and/or in Nature Index Journals in 2020

MSN Graduate Program

At UNAM, Materials Science and Nanotechnology (MSN) graduate program offers a vibrant transdisciplinary academic environment at the Bilkent University Institute of Materials Science and Nanotechnology. We are currently offering Master of Science (M.Sc.) and Philosophy of Doctorate (PhD) degrees under MSN program. Currently, MSN program has 31 M.Sc. students and 35 PhD students.

MSN provides the graduate students with a stimulating educational training in materials and nanoscience-nanotechnology. MSN program ensures the graduate students to conduct high-quality scientific research and technological development in the laboratories equipped with the state-of-the-art facilities at UNAM – The National Nanotechnology Research Center covering the areas of the design and synthesis of advanced and nanostructured materials for the health, energy, environment, water, food, communications, and information technologies as well as the emergent and future technologies. This graduate program is designed to train young scientists and researchers who can pursue creative, outstanding R&D in the various fields of nanoscience-nanotechnology and materials science and engineering, including but not limited to nanobiotechnology, nanomedicine, atomic scale imaging, sensing, nanoelectronics, nanophotonics, femtosecond lasers, nanotextile, nanomaterials, nanofibers, nanotribology, hydrogen economy, and solar energy. The program spans from the fundamental to the applied and innovative research and equips the graduate students with the necessary knowledge and cutting-edge skills to grow into scholar and practicing scientists and researchers who will not be afraid to delve into and be able to offer creative solutions to the challenging problems of today and tomorrow our country and the world are facing. The courses to be taken by the MSN graduate students should focus on the subject of their own thesis work.

Materials Science and Nanotechnology (MSN) Graduate Program is particularly suitable for students who are graduates of Materials Science and Engineering, Physics, Chemistry, Biology, Molecular Biology and Genetics, Electrical and Electric and Electronics Engineering, Mechanical Engineering and want to pursue careers in nanoscience and nanotechnology.

COURSE

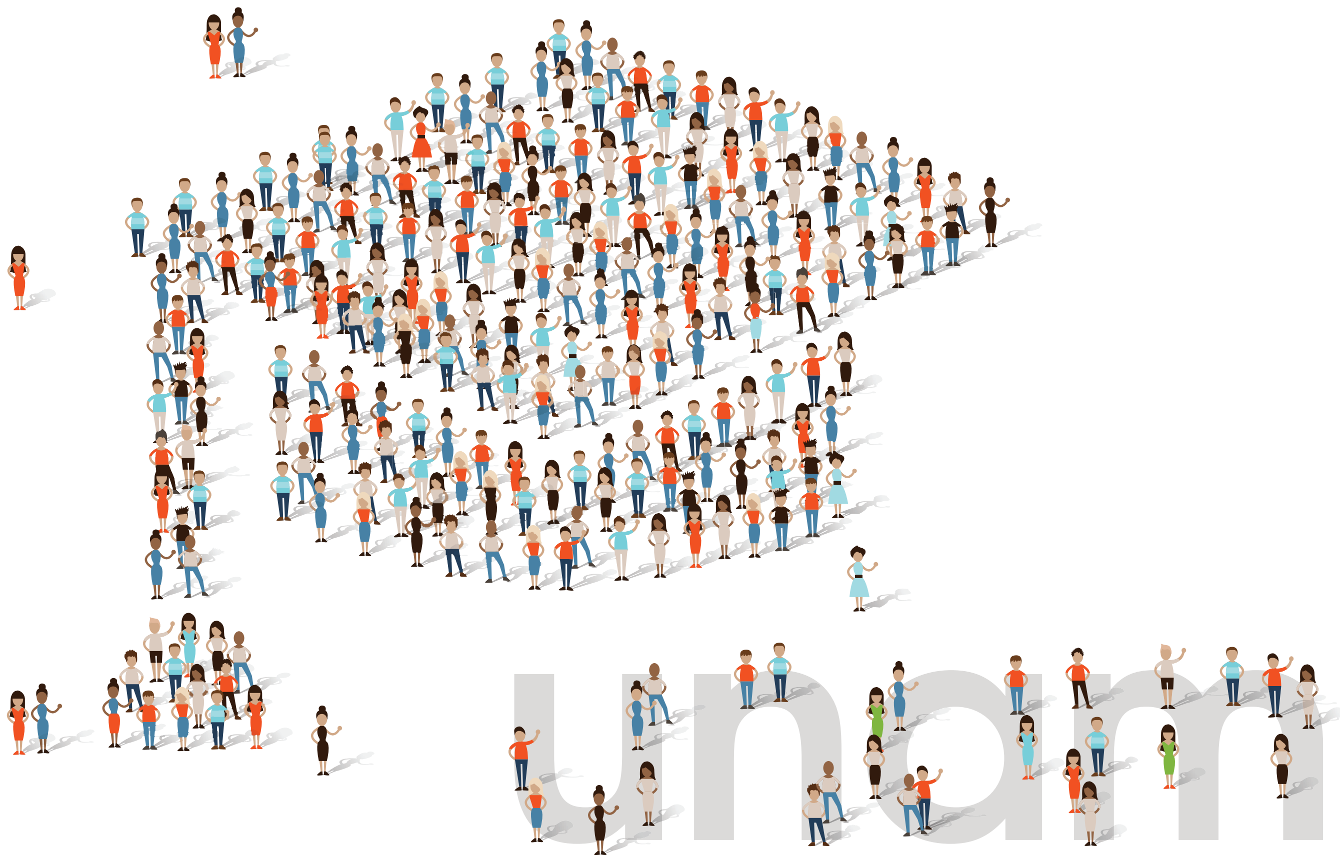
COURSE CODES AND NAMES

CODE	NAME
MSN 500	Concepts in Materials Science
MSN 501	Atomic Structure, Mechanical and Thermal Properties of Materials
MSN 510	Imaging Techniques in Materials Science and Nanotechnology
MSN 512	Biomedical Materials
MSN 514	Computational Methods for Material Science and Complex Systems
MSN 517	Nanoscience and Nanotechnology I
MSN 518	Nanoscience and Nanotechnology II
MSN 519	Applications of Microfluidics and Nanofluidics
MSN 521	Biotechnology
MSN 522	Synthetic Biology
MSN 523	Nanocomposites
MSN 524	Introduction to Mesoscopic Solid-State Materials
MSN 525	Self- Organized and Self-Assembled Systems From Nanoscience to Biotechnology
MSN 526	Functional Surfaces and Interfaces
MSN 527	Quantitative Approaches in Biophysics and Life Sciences
MSN 534	Polymeric Materials
MSN 541	Nanobiotechnology
MSN 551	Introduction to Micro and Nanofabrication
MSN 555	Laser Physics: from Principles to Applications for Materials Science
MSN 598	Seminar I
MSN 599	MS Thesis
MSN 698	Seminar II
MSN 699	PhD Thesis

UNAM Alumni

We are very proud that our alumni are highly sought after both in academia and industry because of the world-class education and training provided at UNAM.

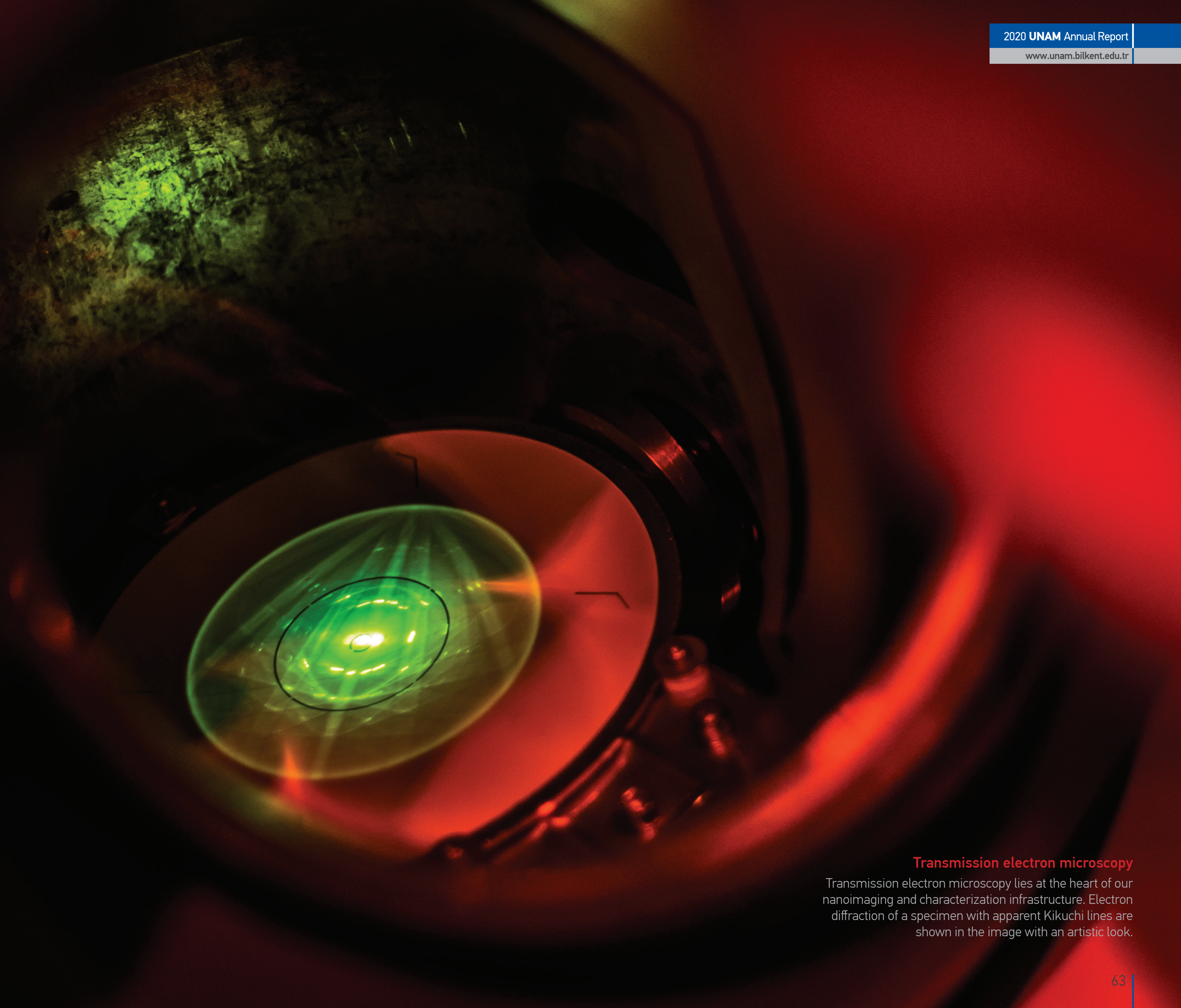
UNAM graduates either select to pursue their careers at the world's leading universities or move to the industry to work at high-tech companies.



Some of UNAM MSN alumni and their current positions can be found in the following list:

- Adem Yıldırım, Postdoctoral Researcher at University of Colorado
- Berna Şentürk, Post-Doc, EMPA at Swiss Federal Laboratories for Materials Science and Technology
- Berna Şentürk, Postdoctoral Researcher at EMPA
- Bilal Kılıç, Faculty Member at Özyeğin University
- Bilge Temiz, Researcher at TÜBİTAK-SAGE
- Bülent Öktem, Lead Laser Design Engineer at ASELSAN
- Burcu Gümüşçü Sefunç, Postdoctoral Researcher at UC Berkeley
- Büşra Mammadov, Product Manager at Sentegen Biotechnology
- Çağla Akgün, Engineer at ASELSAN
- Çağla Eren Çimenci, PhD Student at University of Ottawa Heart Institute
- Ebru Cihan, PhD Student at Karlsruhe Institute of Technology (KIT)
- Egemen Deniz Eren, PhD Student at Technische Universiteit Eindhoven
- Elif Ertem, PhD in Material Science and Engineering Intern at MPM at Cambridge
- Erol Özgür, Postdoctoral Researcher at University of Arizona
- Fatma Kayacı, Specialist at TÜBİTAK-SAGE
- Gökçe Küçükayan Doğu, Process Engineer at Intel Corp.
- Göksu Çınar, Postdoctoral Researcher at KTH Royal Institute of Technology
- Gözde Uzunallı, Postdoctoral Researcher at Purdue University
- Hakan Ceylan, Postdoctoral Researcher at Max Planck Institute
- Handan Acar, Postdoctoral Researcher at University of Chicago
- Hasan Şahin, Faculty Member at Izmir Institute of Technology
- Hilal Ünal Gülsüner, Postdoctoral Researcher at Washington University
- Hülya Budunoğlu, Project Engineer at ASELSAN
- İlke Şimşek Turan, Principle Researcher at Hayat Kimya R&D
- Kıvanç Özgören, General Manager at Fiblas Fiber Lazer San. Tic. Ltd.
- Mehmet Kanık, Postdoctoral Researcher at MIT
- Mehmet Topsakal, Research Associate at Univ. of Minnesota - Brookhaven National Lab.
- Melike Sever, Quality Control Manager at Doku Biyoteknoloji
- Mohammad Aref Khalil, Postdoctoral Researcher at University of Twente
- Mustafa Beter, PhD Student at University of Eastern Finland
- Mutlu Erdoğan, Postdoctoral Researcher at Max Planck Institute
- Nurcan Haştar, PhD Student at Freie University
- Okan Öner Ekiz, Founder and CEO at Nanodev Mühendislik
- Ömer Faruk Sarıoğlu, Researcher at E-Kalite
- Onur Büyükçakır, Postdoctoral Researcher at University of Kaist
- Pelin Tören, Scientist at Joanneum Research
- Rashad Mammadov, Postdoctoral Researcher at Virginia University
- Ruslan Garifullin, Postdoctoral Researcher at Bilkent Üniversitesi
- Ruslan Guliyev, Postdoctoral Researcher at Rutgers University
- Safacan Kölemen, Faculty Member at Koç University
- Samet Kocabey, PhD Student at Ludwig Maximilian University of Munich
- Seher Yaylacı, Faculty Member at Lokman Hekim University
- Seren Hamsici, PhD Student at University of Oklahoma
- Seydi Yavaş, Founder of Lumos Laser at Boğaziçi University
- Seymur Cahangirov, Faculty Member at Bilkent University
- Sündüs Erbaş Çakmak, Faculty Member at Konya Food and Agriculture University
- Taha Bilal Uyar, Research and Development Manager at Coante Quartz Surfaces
- Timur Ashirov, PhD Student at Université de Fribourg
- Tolga Tarkan Ölmez, Postdoctoral Researcher at Yale University
- Turan Selman Erkal, Postdoctoral Researcher at University College London
- Uğur Teğin, PhD Student at Ecole Polytechnique Fédérale de Lausanne
- Veli Ongun Özçelik, Postdoctoral Researcher at Princeton University
- Yusuf Çakmak, Postdoctoral Researcher at Konya Food and Agriculture University
- Yusuf Keleştemur, Postdoctoral Researcher at ETH Zurich
- Zeynep Aytaç, Postdoctoral Researcher at University of Michigan

Principle Investigators at UNAM



Transmission electron microscopy

Transmission electron microscopy lies at the heart of our nanoimaging and characterization infrastructure. Electron diffraction of a specimen with apparent Kikuchi lines are shown in the image with an artistic look.

Principle Investigators at UNAM

MICHELLE ADAMS
PhD New York University Neuroscience Graduate Program,
Dept. of Psychology and UNAM

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Research interests: *Cellular and synaptic changes in the aging brains*

AYÇA ARSLAN ERGÜL
PhD Bilkent University
MSN Graduate Program and UNAM

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Research interests: *Cellular aging, neurogenesis, transcriptomics, telomeres, zebrafish*

ABDULLAH ATALAR
PhD Stanford University
Dept. of Electrical and Electronics Engineering, and UNAM

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Research interests: *Micromachined sensors, analog and digital integrated circuit design*

AMIRHOUSHANG BAHRAMI
Ph.D. Technical University Berlin
MSN Graduate Program and UNAM

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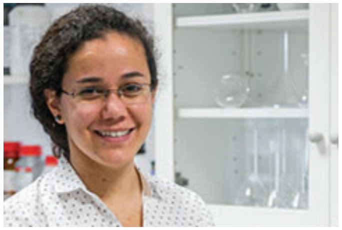
Research interests: *Active/living matter and biophysics, biomembranes and vesicles, cellular mechanics and mechanobiology, cellular and biological processes, cellular uptake of nanoparticles and drug delivery, synthetic biology, computational nanofluidics*



BİLGE BAYTEKİN
PhD Freie Universitat Berlin
Dept. of Chemistry and UNAM

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Research interests: *Mechanochemistry, polymers for energy applications, soft robots*

LUCA BIANCOFIORE
PhD, University of Nice
Dept. of Mechanical Engineering and UNAM

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Research interests: *Computational fluid dynamics, fluid lubricated contacts, phase change, complex rheology, active particles and micro-/nano-films.*

SEYMUR JAHANGIROV
PhD Bilkent University
MSN Graduate Program and UNAM
Interdisciplinary Neuroscience Program

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Research interests: *Computational condensed matter physics, complex systems, computational neuroscience*

MURAT ALPER CEVHER
PhD The City University of New York
Dept. of Molecular Biology and Genetics, and UNAM

murat.cevher@bilkent.edu.tr

Research interests: *Transcription, transcription factors, mediator complex, multibac baculovirus based recombinant protein synthesis, nuclear receptors and breast cancer*

Principle Investigators at UNAM

SALİM ÇIRACI
PhD Stanford University
Dept. of Physics and UNAM

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***Research interests:** Super-low friction, hydrogen storage, molecular electronics, spintronics, nanowires*

ONUR ÇİZMECİOĞLU
PhD Cell Biology, University of Heidelberg Dept. of Molecular Biology and Genetics, and UNAM

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***Research interests:** Mitogenic signaling pathways, cell cycle, cancer therapy and*

ÖMER DAĞ
PhD Middle East Technical University
Dept. of Chemistry and UNAM

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***Research interests:** Mesoporous metal oxide, metal sulfide, and metal selenide materials, lyotropic liquid crystals and gel electrolytes, porous thin film electrode materials*

BAHAR DEĞİRMENCİ
PhD University of Zurich
Dept. of Molecular Biology and Genetics, and UNAM

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***Research interests:** Intestinal stem cell niche, organoids, pathway cross-talks, colorectal cancer, obesity.*

ABDULLAH DEMİR
PhD University of Central Florida
MSN Graduate Program and UNAM

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***Research interests:** Optoelectronics, nanophotonic devices, semiconductor lasers, high power laser diodes, VCSEL, quantum cascade lasers, nanoscale light sources*

HİLMİ VOLKAN DEMİR
PhD Stanford University
Dept. of Electrical and Electronics Engineering, Dept. of Physics and UNAM

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***Research interests:** Nanophotonics, nanocrystal optoeelectronics, devices and sensors, light-emitting diodes, implatable electronics*

ENGİN DURGUN
PhD Bilkent University
MSN Graduate Program UNAM

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***Research interests:** Hydrogen storage, 2D ultrathin material systems, solar-thermal fuels, cement chemistry, ferroelectric and multiferroic materials*

ÇAĞLAR ELBÜKEN
PhD University of Waterloo
MSN Graduate Program and UNAM

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***Research interests:** Microdroplet-based microfluidic systems, integrated microfluidic systems*

Principle Investigators at UNAM

BARBAROS ÇETİN
Ph.D. Vanderbilt University
Dept. of Mechanical Engineering and UNAM

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Research interests: *Microfluidics for biological and chemical applications, modeling of particulate flow for microfluidics, micro-scale heat transfer*

AYKUT ERBAŞ
PhD Technical University of Munich
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Research interests: *Statistical mechanical and thermodynamic description of soft matter, biophysics, polymer physics*

EBRU ERBAY
PhD University of Illinois, UC
Dept. of Molecular Biology and Genetics, and UNAM

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Research interests: *Lipotoxic endoplasmic stress, cardiometabolic syndrome, inflammation mechanics, disease modeling*

YEGAN ERDEM
PhD UC Berkeley
Dept. of Mechanical Engineering and UNAM

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Research interests: *Microfluidic reactors and networks, MEMS, nanosensors, energy harvesting*

ALİ OSMAY GÜRE
PhD Cornell University
Dept. of Molecular Biology and Genetics, and UNAM

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Research interests: *Cancer biology, antibody and gene expression profiling, biomarker discovery*

İHSAN GÜRSEL
PhD Middle East Technical University
Dept. of Molecular Biology and Genetics, and UNAM

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Research interests: *Immune therapeutic applications of nanobiotechnology and nanobiomaterials. Vaccine and adjuvant design to cure cancer, infectious diseases and allergy.*

OĞUZ GÜLSEREN
PhD Bilkent University
Dept. of Physics, and UNAM

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Research interests: *Theoretical condensed matter physics, nanoscience, graphene, solar cells, plasmonics, metal nanowires, carbon nanotubes, electronic structure of solids, material properties from first principles*

SERKAN İSMAİL GÖKTUNA
PhD Technical University of Munich
Dept. of Molecular Biology and Genetics, and UNAM

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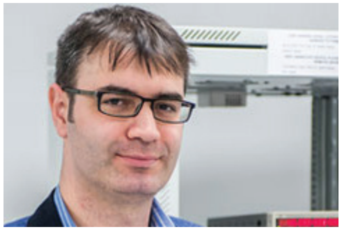
Research interests: *Cancer biology, gastrointestinal cancers, tumor immunology, signal transduction*

Principle Investigators at UNAM



SELİM HANAY
PhD Caltech Dept. of Mechanical Engineering and UNAM

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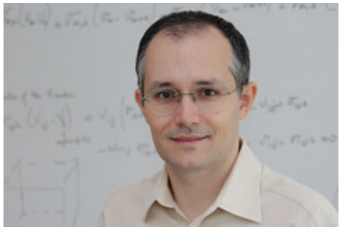
Research interests: *Biosensor design, MEMS and NEMS, on-chip mass spectroscopy*



FATİH ÖMER İLDAY
PhD Cornell University
Dept. of Physics, Dept. of Electrical and Electronics Engineering and UNAM

ilday@bilkent.edu.tr

Research interests: *Fiber lasers, nonlinear and ultrafast optics, biomedical applications of lasers, nonlinear and stochastic dynamics, micro- and nano-structuring of matter via laser light, and nanophotonics*

FATİH İNCİ
PhD İstanbul Technical University
MSN Graduate Program and UNAM

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Research interests: *Precision Health, Point-of-care Diagnostics, Biosensors, Microfluidics, Nanoplasmonics, Micro/ Nano-scale Technologies, Bio-inspired Sensors, Mobile Health (mHealth), Infectious Diseases, Global Health, Disease Early Diagnosis and Screening*

HULUSİ KAFALIGÖNÜL
PhD University of Houston
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Research interests: *Cognitive Neuroscience, Neurophysiology, Neuroimaging, Neurobiology, Aging*

FERDİ KARADAŞ
PhD Texas A&M
Dept. of Chemistry and UNAM

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Research interests: *Hydrogen storage, water oxidation catalysis*

YİĞİT KARPAT
PhD Rutgers University
Dept. of Industrial Engineering, Dept. of Mechanical Engineering, and UNAM

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Research interests: *Mechanical micro machining, ultra precision diamond machining, thermal energy micro machining, , micro additive manufacturing*

TALİP SERKAN KASIRGA
PhD University of Washington
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Research interests: *Strongly correlated materials, 2D materials*

SERİM KAYACAN İLDAY
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Research interests: *Self-assembly, self-organization, complexity, far-from-equilibrium thermodynamics, nonlinear and stochastic dynamics, adaptive hierarchical materials, emergent phenomena*

Principle Investigators at UNAM

ÖZLEN KONU

PhD Texas Tech University
Dept. of Molecular Biology and Genetics, Neuroscience Graduate, and UNAM

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Research interests: *Bioinformatics and genomics, cellular signaling in cancer, drug screening and disease models in zebrafish*

HAYRETTİN KÖYMEN

PhD University of Birmingham
Dept. of Electrical Engineering and UNAM

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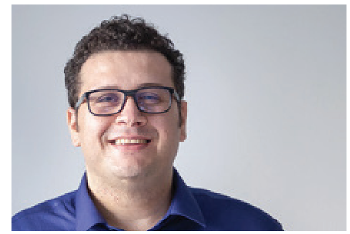
Research interests: *Acoustics, ultrasonics, electronics, transduction, micromachined sensors*



HALİL İBRAHİM OKUR

PhD Penn State University Department of Chemistry and UNAM

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Research interests: *Biointerfaces, water, nano-emulsions, biomacromolecules, lipid droplet organelles, specific ion effects, nonlinear spectroscopy, second harmonic generation*

MUSTAFA ORDU

PhD Boston University
MSN Graduate Program and UNAM

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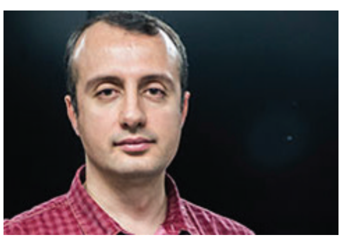
Research Interests: *Semiconductor-core fibers, Photonic crystal fibers (PCF), Fiber micromachining with lasers*



BÜLEND ORTAÇ

PhD University of Rouen
MSN Graduate Program and UNAM

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Research interests: *Fiber lasers, saturable absorbers, development of high-power fiber amplification systems*

EKMEL ÖZBAY

PhD Stanford University
Dept. of Electrical and Electronics Engineering, Dept. of Physics, NANOTAM, and UNAM
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Research interests: *Nanophotonics, metamaterials, plasmonics, photonic crystals, GaN/AlGaN devices, MOCVD growth*

TAYFUN ÖZÇELİK

M.D. İstanbul University
Dept. of Molecular Biology and Genetics, and UNAM

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Research interests: *Identification of inherited gene mutations, neurodevelopmental disorders, X-chromosome inactivation and autoimmunity, genetic predisposition to cancer*

EMRAH ÖZENSOY

PhD Texas A & M University
Dept. of Chemistry and UNAM

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Research interests: *Heterogeneous catalysis and Photocatalysis, nanomaterials for energy storage and conversion, environmental catalysis, renewable energy systems, spectroscopy and surface science*

Principle Investigators at UNAM

İBRAHİM SARPKAYA

PhD Stevens Institute of Technology
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Research interests: *Carbon nanotube and 2D material based nanophotonics, experimental quantum optics, plasmonics*

ŞEFİK SÜZER

PhD UC Berkeley
Dept. of Chemistry and UNAM

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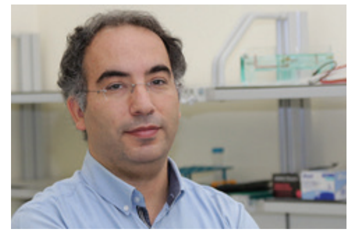
Research interests: *Layer-by-layer deposition and their antibacterial applications, electrical investigation on nano-scale structures with dynamic XPS, tribochemistry investigation of various materials, wettability of surfaces*



URARTU ŞEKER

PhD Istanbul Technical U.
MSN Graduate Program and UNAM

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Research interests: *Synthetic biology, genetically engineered organisms biodevices, genetic engineering and protein engineering at the bio-nano interface, medical biotechnology*

ERDİNÇ TATAR

PhD Carnegie Mellon University
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Research interests: *Micro ElectroMechanical Systems (MEMS), Inertial sensors, Strain sensing, Microfabrication Technologies, Bio-inspired sensors, Acoustic gas sensing, Sensor control electronics*

DÖNÜŞ TUNCEL

PhD University of Cambridge and Imperial College
Dept. of Chemistry and UNAM

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Research interests: *Design and synthesis of novel organic and inorganic/organic hybrid, nanostructured functional materials with potential applications in the areas of photonics, photocatalysis and bionanotechnology*

ONUR TOKEL

PhD Cornell University
Dept. of Physics and UNAM

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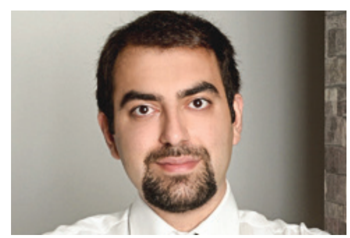
Research interests: *Fundamental light-matter interactions, from state-selective laser photolysis dynamics to fundamental photonics; and applying the resulting understanding towards novel micro/nano-fabrication technologies and optical devices*



YUNUS EMRE TÜRKMEN

PhD Univ. of Chicago
Dept. of Chemistry and UNAM

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Research interests: *Organocatalysis, Biomimetic catalyst design, Sustainable chemistry, Synthetic methodology development*

BURAK ÜLGÜT

PhD Cornell University
Dept. of Chemistry and UNAM

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Research interests: *Impedance based models of energy storage and conversion systems. Instrumentation, in-situ electrochemical techniques. Electrochemical noise measurements*

Principle Investigators at UNAM

GÜRKAN YEŞİLÖZ
Ph.D. University of Waterloo
MSN Graduate Program and UNAM

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Research interests: *BioMEMS, micro/nanofluidics devices, organ-on-chips and physiological systems, tissue engineering, drug delivery and drug screening, pathogen detection, droplet microfluidics, acoustofluidics, microwave integrated sensors/heaters, nanoparticle synthesis and multiphase fluid interactions*

IŞIK YULUĞ
PhD University of London
Dept. of Molecular Biology and Genetics, and UNAM

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Research interests: *Transcriptional mapping of human chromosomes, Mapping of genes in human and mouse, Molecular genetics and biology of inherited cancers, Somatic cell genetics*

MEHMET YILMAZ
PhD Columbia University
MSN Graduate Program and UNAM

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Research interests:
Micro/nanofabrication, in-situ SEM nanomechanical characterization, MEMS, CMUT

HASAN YILMAZ
Ph.D. University of Twente
MSN Graduate Program and UNAM

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Research interests: *Experimental and computational optics and photonics, light scattering, optical imaging and spectroscopy, computational imaging, wavefront shaping, spatiotemporal control of light, complex photonic materials, mesoscopic physics of light, statistical optics, laser physics, random matrix theory.*

SEMİHA YILMAZER
PhD Karadeniz Technical University
Dept. of IAED and UNAM

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Research interests: *Building physics, physical and mechanical properties of building materials with particular emphasize on acoustics, thermal and humidity behaviours, building construction, room acoustics, architectural lighting.*

Principle Investigators at UNAM

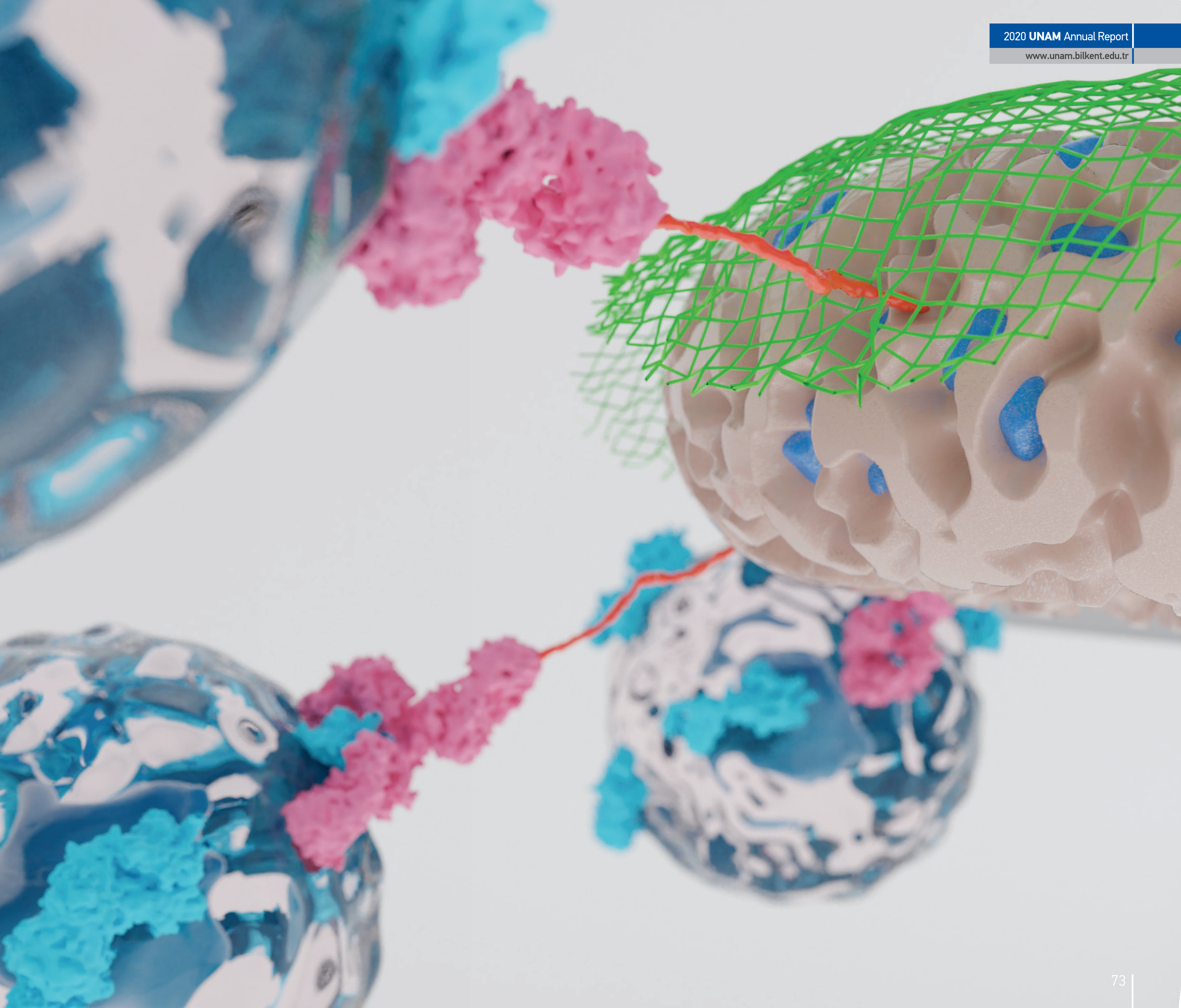
Principle Investigators at UNAM

TOTAL

53

unam excellence in science and technology

UNAM Research Group Highlights



Alterations in Neural Cells and Synapses with Aging and Diet

Our laboratory's research focus is aimed at understanding age-related alterations in neural cells and synapses and effects of dietary restriction (DR) in preventing these changes. We are determining the molecular pathways through which DR is exerting these effects to develop possible drug mimetics that would be translatable to human populations.

Aging is a complex process, regulated by the interplay between genetic and environmental factors with multifactorial changes affecting many systems. Normal aging is accompanied by cognitive decline and understanding the mechanisms at the cellular and synaptic levels will provide insight into the biological changes that underlie this decline. Developing strategies for ameliorating and preventing cognitive changes and potential translational therapies for the aging population are important goals. Dietary restriction (DR) is a dietary regimen that is based on lowering the daily caloric intake. DR animals have higher mean life and health spans, delayed age-related physiological changes, and better performance on memory tasks. The differential effects of DR, such as the gender of the subject, timing and duration, as well as the specific molecular mechanisms of DR are unknown. Also, development of potential DR-mimetics, drugs that mimic the effects of DR, is important. We are using the zebra fish as a model organism to study the effects of aging and DR on changes in neural cells and synapses because just like humans they age gradually and many genetic tools are available for determining the mechanisms of DR in these animals. Thus far, we have observed that neurogenesis is decreased in aged animals and synaptic protein levels show a sexually dimorphic pattern with brain aging.

MICHELLE ADAMS

PhD New York University Neuroscience Graduate Program,
Dept. of Psychology and UNAM

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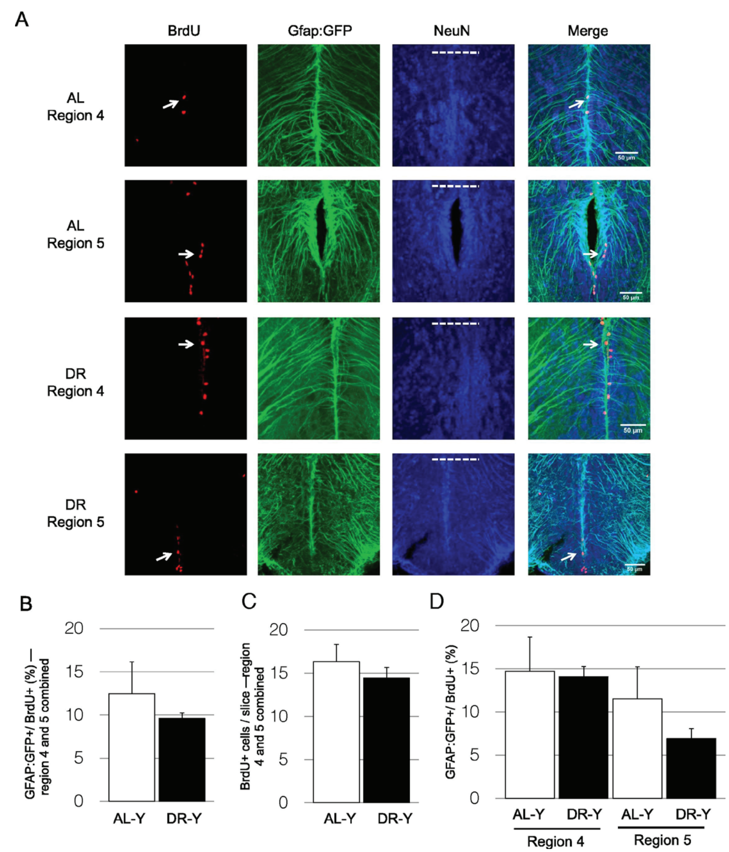
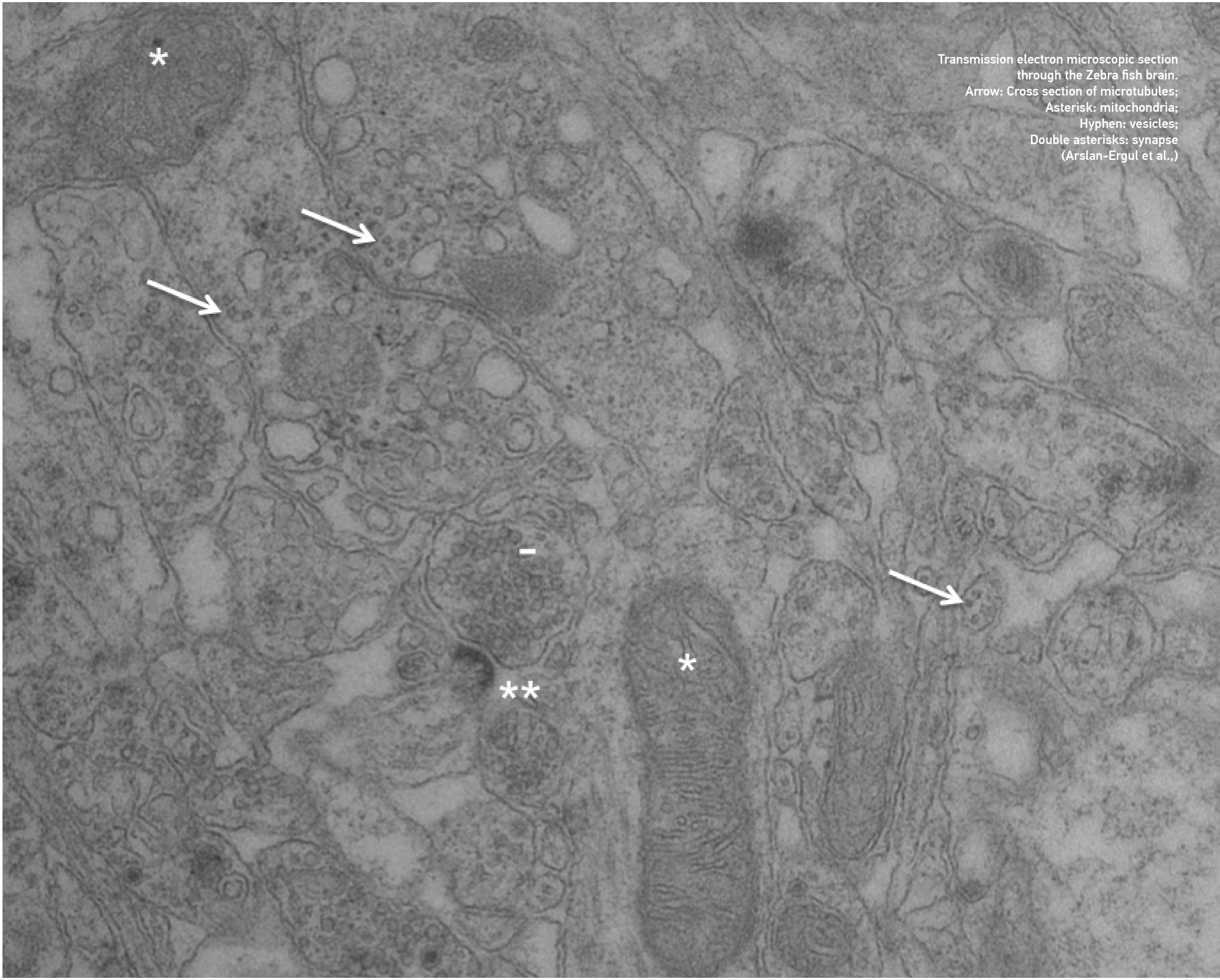
***Research interests:** Cellular and synaptic changes in the aging brains*

We have begun to apply an every-other-day DR feeding regimen to determine the effects of these interventions on neural cells and synapses. Initial data indicates that telomere lengths but not neurogenesis rates are affected by age and DR. We are currently using a DR-mimetic, rapamycin, which blocks the nutrient signaling pathway to examine the molecular mechanisms of DR. Moreover, we are creating transgenic fish with changed in the nutrient signaling pathway to determine if we can obtain accelerated or decelerated aging models. protein levels show a sexually dimorphic pattern with brain aging. We have begun to apply CR and CR-mimetics to determine the molecular pathways of these interventions.





Transmission electron microscopic section through the Zebra fish brain.
Arrow: Cross section of microtubules;
Asterisk: mitochondria;
Hyphen: vesicles;
Double asterisks: synapse
(Arslan-Ergul et al.,)

Arslan-Ergül Group

As Arslan-Ergul lab, our research interest can be summarized in one word as aging. We investigate aging at the cellular level, and observe the outcome at disease and behavior level. At the cellular level, we work on cells, – cancer cell lines, primer cells, and stem cells, zebrafish brain, and human derived stem cells. At the behavior level, we test zebrafish for learning and memory. At the disease level, we are working on patient materials from Hacettepe Hospitals. We are jointly utilizing laboratories at Bilkent National Nanotechnology Research Center (UNAM), Hacettepe Stem Cell Center, Hacettepe Department of Pediatric Neurology, Bilkent University Brain Research Center, and Zebrafish Facilities.

In the last three years, we have been culturing brain stem cells from young and old zebrafish, and subject them to RNA sequencing, BrdU labeling methods. Our aim is to compare the stem cells obtained from old brain to those from young brain, reveal the gene expression differences, and understand the function of stem cells in aging process. In young stem cells, we activate the genes that are found to be significantly changed in RNA sequencing and perform intracranial transplantation to the old zebrafish brain. Then we investigate the behavior of these cells in neurogenesis processes.

In another project, we compared old (25-months old) and young (8-months old) zebrafish and found hypomethylation regions in old zebrafish brains, when compared to young ones. We used qPCR to measure telomere lengths and hTERT promoter methylation levels. For this purpose, we did bisulfate treatment, and amplified hTERT promoter region. In the samples that had short telomere lengths, we found DNA hypomethylation. We think that these regions are associated with telomere shortening. We are currently testing this hypothesis in brain cancer cell lines.

A different yet interesting project that we are involved in is the transcriptomics of the pearl mullet fish. Pearl mullet (Chalcalburnus tarichi) is an endemic fish, living in Lake Van. It spends most of its life in the high soda (pH=9.8) and saline waters of Lake Van, but migrates to freshwater streams flowing into the lake for spawning. This exceptional adaptation is equaled by only two other species in the world. Our project is an extension of the Pearl Mullet Genome project and aims to identify the transcriptome of this species. We work with Mehmet Somel (METU, Bio), Vahap Eldem (İstanbul Uni, Bio), Can Alkan (Bilkent Uni, CS), Arzu Karahan (METU, Marine Sci.), and Mustafa Sarı – aka father of the pearl mullet (Bandırma Uni, Marine Sci.)

AYÇA ARSLAN ERGÜL
PhD Bilkent University
MSN Graduate Program and UNAM

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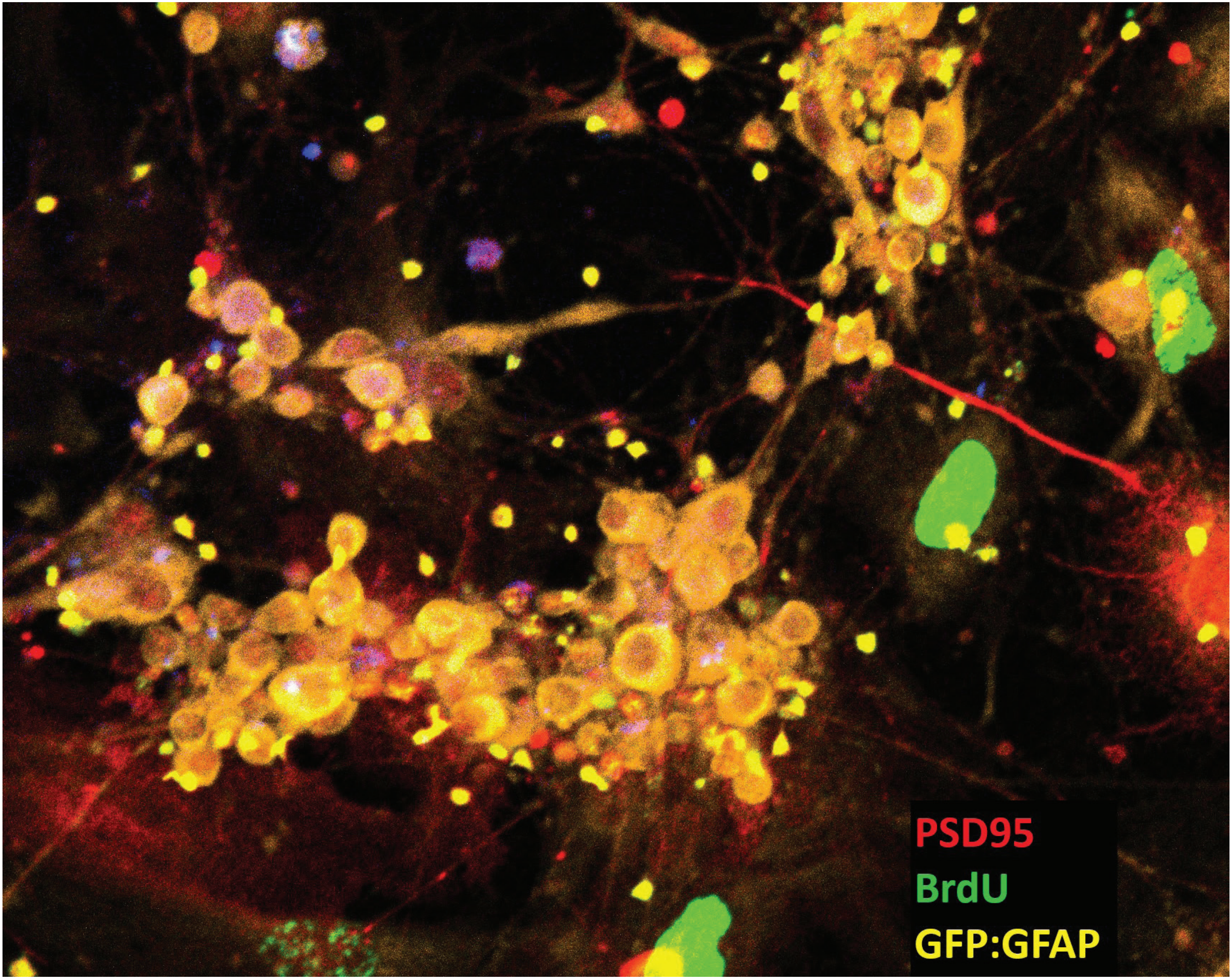
Research interests: *Cellular aging, neurogenesis, transcriptomics, telomeres, zebrafish*


PSD95
BrdU
GFP:GFAP

Mechanochemistry

In our research group, we develop new materials and methods to efficiently convert mechanical energy to chemical energy.

Mechanochemistry is the conversion of mechanical energy exerted on materials (i.e. tension, compression, or even a simple contact of two surfaces) to chemical energy via chemical bond breakages. The increasing demand for finding new energy sources and ever-increasing value of feedstock materials recently boosted the interest in mechanochemical research for finding new pathways for energy conversions and development of new technologies e.g. in the field of recycling. Our research group aims to find such systems to perform efficient mechanical-to-chemical energy conversions.

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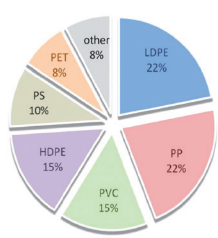
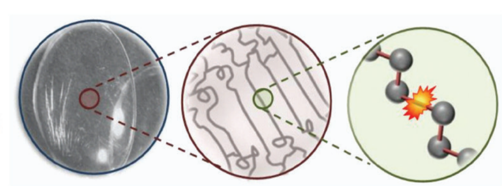
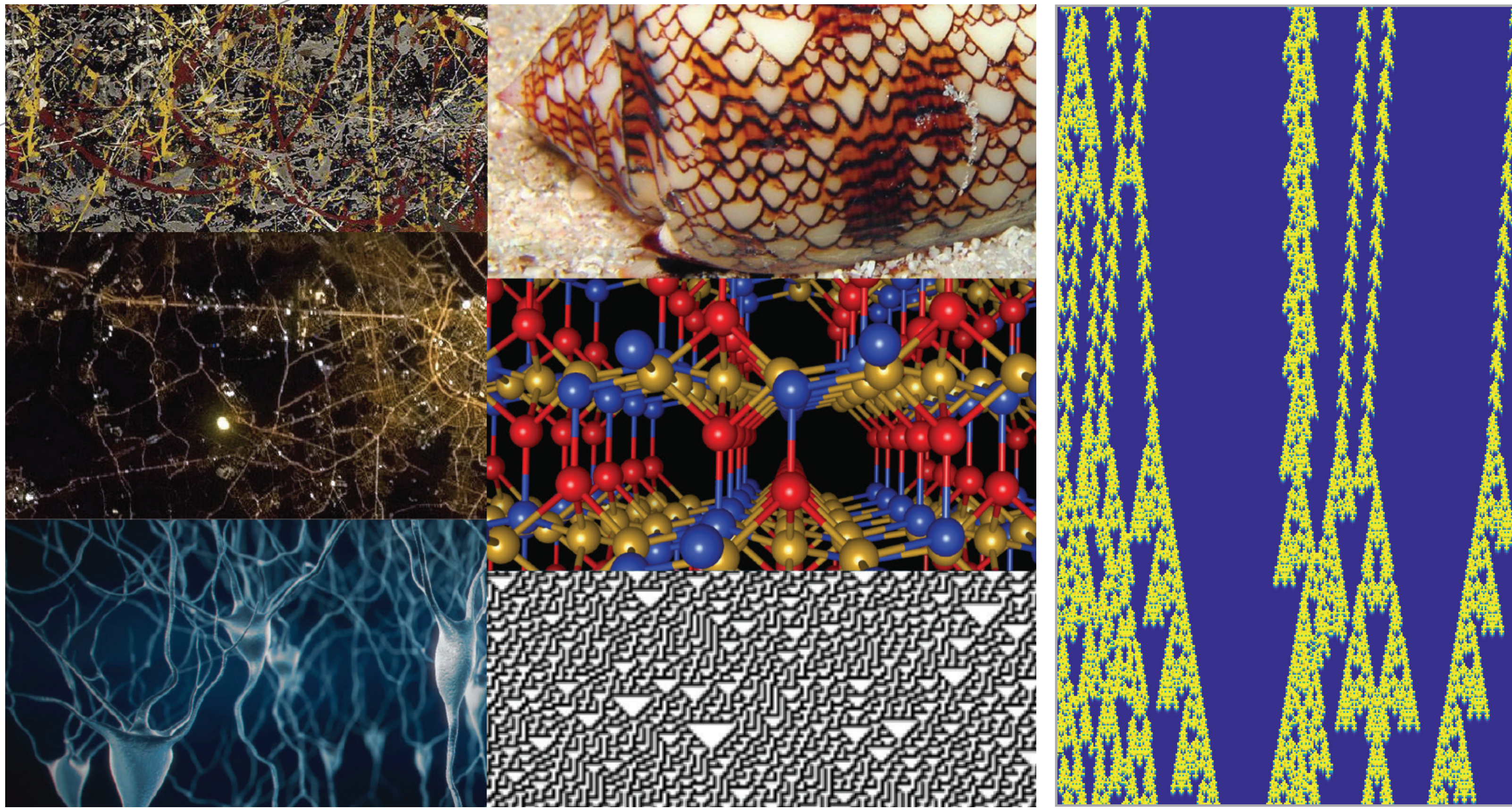
Mechanochemistry, polymers for energy applications, soft robots

Polymer mechanochemistry

Growth in the production of polymeric materials (reaching 245 million tons per annum as of 2009, with estimated worldwide sales of $454 billion, which are expected to reach $567 billion by 2017, with an average growth rate of 3.8% between 2012 and 2017) and the expansion of their uses make polymers a primary class of materials. Polymer mechanochemistry has recently gained more importance with the growth in production of polymer materials as well as with the growing interest in retrieving energy from organic/polymer materials. In our group, we both work on mechanochemistry of the common polymers produced and used in large quantities everyday, and also produce new materials and methods that will finally be reflected in innovative technologies i.e. in energy conversion and recycling.







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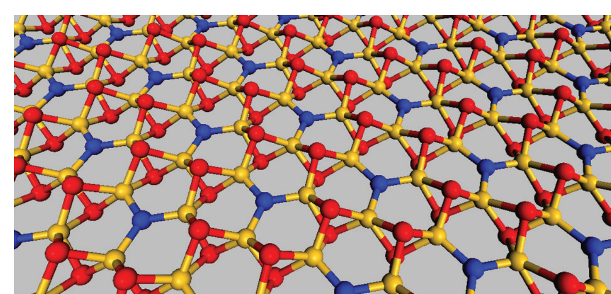
Research interests: *Computational condensed matter physics, complex systems, computational neuroscience*

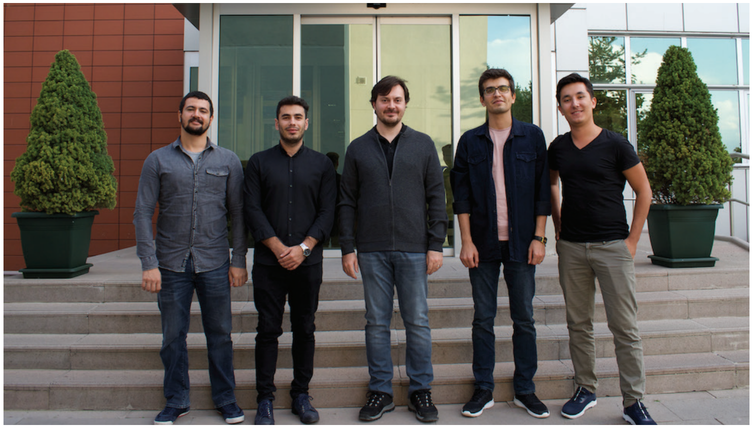
Computational Universe

The universe is computational at its essence. It is woven with mathematical consistency out of information fabric. Computers are used to probe the universe at all scales, from atoms to galaxies. Our group explores the computational universe in search of novel materials and intelligent life.



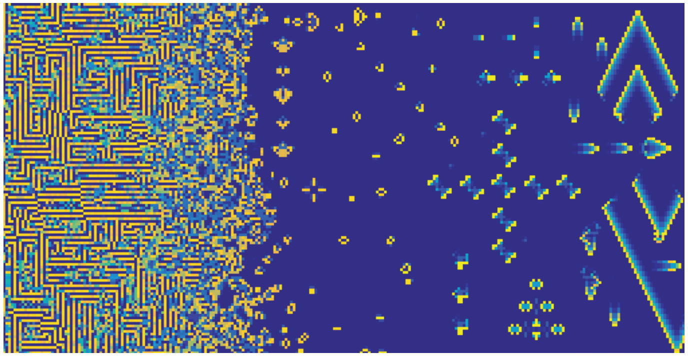
Discovering Novel Materials

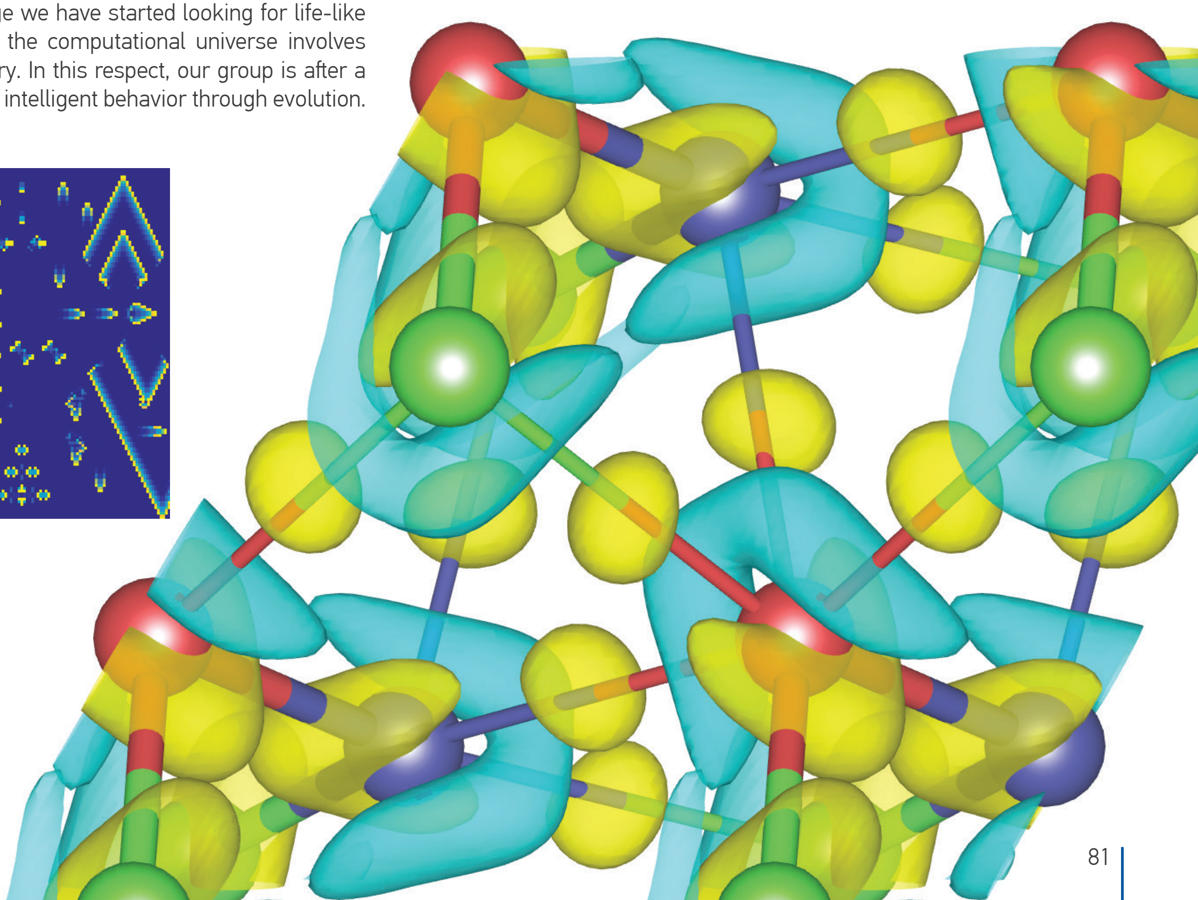
A century after quantum mechanics was conceived, we are now able to predict the stability and physical properties of materials that don't even exist in Nature. Our predictions have enough precision to guide or understand experimental studies. This precision is reached by implementing the Density Functional Theory in efficient algorithms that run in supercomputers.



Artificial Life

The universe is painstakingly explored by ever stronger telescopes in search of places that can inhabit life. Since the dawn of the information age we have started looking for life-like behavior in our computers. Such an exploration in the computational universe involves building models that aspire to biological neurocircuitry. In this respect, our group is after a simple computational model of brain that can acquire intelligent behavior through evolution.





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Research interests: *Optoelectronics, nanophotonic devices, semiconductor lasers, high power laser diodes, VCSEL, quantum cascade lasers, nanoscale light sources*

Nanophotonic Devices

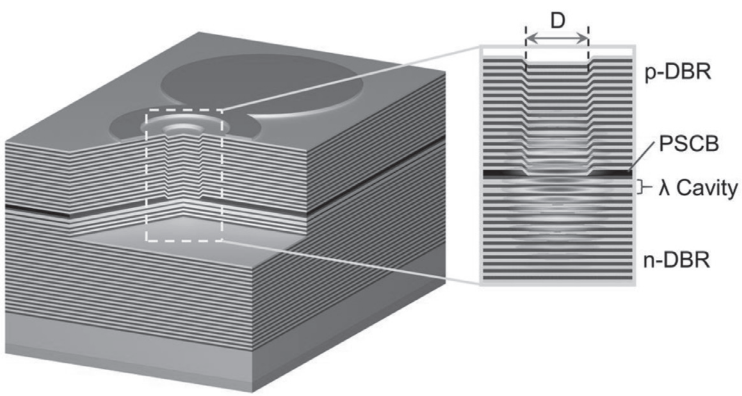
Our research focuses on the design, simulation, fabrication, and testing of novel nanophotonic devices targeting diverse applications.

The future “digital economy” and “green” technologies need more energy efficient devices than today. Optoelectronics and photonics have contributed extensively in these areas and can help reduce the energy budget and increase the capabilities of these technologies with innovative photonic components and light sources. To this end, we work on the development of novel nanophotonic devices and semiconductor laser technologies. Today, they are employed in a wide range of applications in information communication technologies, medical diagnostics, industrial cutting/heating systems, infrared illumination for surveillance, 3D sensors, light detection and ranging (LIDAR), homeland security and military, environmental monitoring and self-driving cars. Advances in these devices require the development of disruptive technologies that involve industry-oriented mindset with a scientific research approach, a deep understanding of the current technology and its limits.

In the nanoPhD Lab, we work on novel device architectures with unprecedented features and abilities. We design the epitaxial structure of photonic devices with nanoscale precision. We also use simulation tools to study and understand their thermo-opto-electronic behavior. The designed nanophotonic devices are manufactured in our clean rooms using micro- & nano-fabrication processes developed by the group and finally tested in our laboratory.

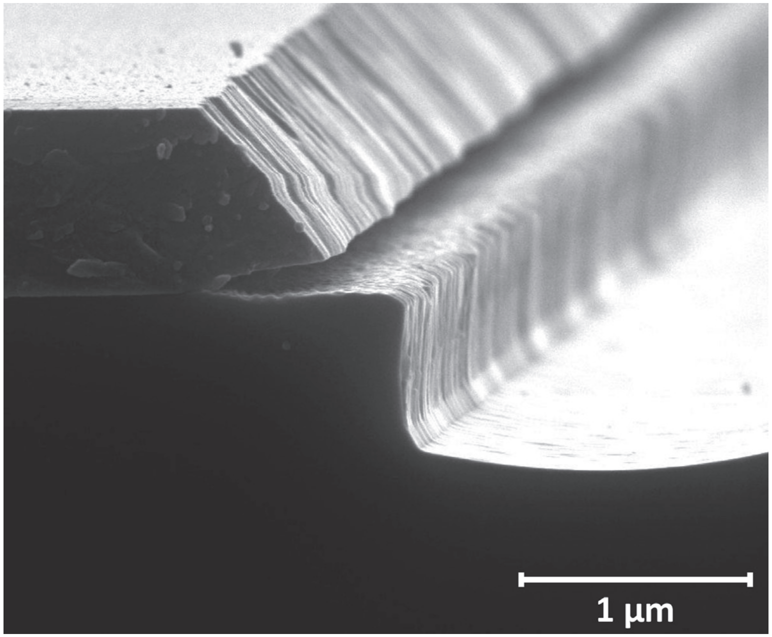
Our projects embrace both applied science and industry-oriented research. Our expertise includes a wide range of nanophotonic devices: semiconductor lasers, high-power laser diodes, vertical cavity surface emitting lasers (VCSEL), low-dimensional quantum well/dot structures, nanolasers, parity-time symmetry in lasers and quantum cascade laser (QCL).

One of our fundamental research goal is to extend our industrial research results on laser power enhancement. Within the last decade, it remained challenging to increase the output power of semiconductor lasers. Various explanations were proposed to limit laser power, but the physical mechanisms have remained unclear. Our work showed that both linear and non-linear losses contribute to laser power limitation. As a solution, we proposed semiconductor laser power increase by control of gain and power profiles. By employing this method, we demonstrated world record laser power. We also work on approaches that can potentially lead to diffraction limited high-power laser chips. For this purpose, we conduct simulation and experimental studies on parity-time symmetry in semiconductor lasers.



We also develop novel architectures to solve the longstanding problems of laser diodes. Catastrophic optical mirror damage (COMD) has been known as a fundamental issue limiting both device reliability and performance of semiconductor lasers. It is a heating induced failure of the output facet and, hence, the laser diode. Recently, we demonstrated a method to isolate the generated heat of the laser from its temperature sensitive output facet. We showed facet cooling of a semiconductor laser with facet temperatures far below the bulk temperature of the laser cavity without compromising the laser performance.

Progress in laser miniaturization started with the invention of VCSELs. However, it has been impossible to achieve manufacturable nanolasers using the existing technology. Other small size laser approaches have been demonstrated in the past few decades such as micro-disks, photonic crystals, nanowire, and plasmonic lasers with limited success. We have recently started working on a method to develop a novel growth and fabrication process for manufacturable nanolasers.



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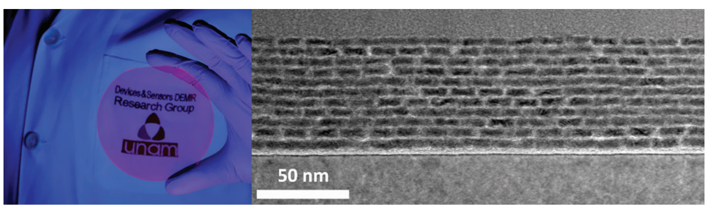
Research interests: *Nanophotonics, nanocrystal optoeelectronics, devices and sensors, light-emitting diodes, implatable electronics*

Quantum Materials, Devices and Sensors

The Demir Research Group is working on high-tech material platforms and innovative devices embedded with nanoscale functional structures. Under the leadership of Professor Hilmi Volkan Demir, the research group focuses on studying semiconductor optoelectronics of nanocrystals including colloidal quantum dots and colloidal quantum wells, physics of colloidal nanophotonics, and nanoparticle photonics. Also, the team develops energy-transfer driven quantum devices/sensors and light-emitting diodes for quality lighting, as well as bioimplants, implantable electronics, and medical devices.

The Demir Group has published over 350 peer-reviewed research articles in major scientific journals. In 2020, out of 23 publications, 16 of them appeared in Nature Index Journals and/or journals with IF~10 and above. The Group Leader Professor Demir received the 2020 TÜBİTAK Science Award in the field of engineering. Another important event of 2020 was the election of Professor Demir as a Fellow of IEEE and as a full Academy Member of TÜBA – the Turkish Academy of Sciences. Prof. Demir's promotion to IEEE Fellow status recognizes his distinct and pioneering contributions to the advancement of semiconductor nanocrystal optoelectronics, semiconductor lighting and nanophotonics.

Colloidal quantum wells (CQWs) are the most recent class of size-tunable atomically-flat semiconductor nanocrystals. These quasi-two-dimensional nanoparticles exhibit highly desirable optical properties for optical gain and lasing. One way of utilization of these CQWs as optical gain media is their deposition onto surfaces as thin films. These thin films should possess sufficient thickness and uniformity to provide optical gain. Conventional methods for thin film preparations including spin coating or drop casting, however, occasionally suffer from inhomogeneity or lack reproducibility.
In the recent report [Nano Letters 2020], our research team led by Prof. Hilmi Volkan Demir, showed a powerful technique for creation of highly homogeneous CdSe/CdZnS CQWs thin films, which is based on liquid interface self-assembly. This technique enables deposition of close-packed CQWs one monolayer at a time, thereby enabling unprecedented control over the resulting colloidal film thickness while maintaining the excellent uniformity of the deposited monolayers across areas as large as 80 cm^2. Using this method, our team created CQW films of varying thickness and demonstrated that optical gain on a fused silica substrate could be observed at a mere 42 nm thickness, which is the thinnest ever reported gain medium on a bare planar substrate. We further studied the properties of optical gain in these CQWs depending on the film thickness, and demonstrated the evolution of the gain threshold and wavelength with film thickness. Our study presents a versatile bottom-up construction technique for CQW thin films, which can be extended to large-area device fabrication.



[Nano Letters 2020, 20, 6459–6465 (Nature Index Journal)].

Another important contribution was the demonstration of ultralow-threshold microfluidic single-mode laser using an on-chip cavity. We showed the first account of in-solution colloidal nanocrystal based microfluidic waveguide and single-mode laser. A microfluidic waveguide was fabricated by soft lithography and photolithography techniques using PDMS (in collaboration with Dr. Y. Erdem). The waveguides were then filled with CQWs solution using capillary filling to obtain amplified spontaneous emission (ASE) with a record low threshold of 17.1 $\mu J.cm^{-2}$ from the core/crown@gradient-alloyed shell CQWs solution. A high-quality Fabry Pérot cavity was also created in this device by depositing SiO_2-protected air-stable Ag mirrors to generate lasing action. Combined with the highly reflective mirrors, the outstanding optical properties of CQWs allow for the realization of such a single-mode laser with an ultralow lasing threshold of 68.4 $\mu J\ cm^{-2}$, which is three orders of magnitude lower than the best previously reported thresholds among all solution based lasing demonstrations. These realized record low thresholds emanate from the team's high-quality core/crown@gradient-alloyed shell CQWs having giant gain cross-section and slow Auger rates.

[Advanced Materials 2021, 33.2007131, (Nature Index Journal)].

Another study conducted by Demir Research Group in 2020 was the demonstration of sub-single exciton level of optical gain threshold in specially engineered CdSe/CdS@CdZnS core/crown@gradient-alloyed shell quantum wells. In this study, Professor Demir's research team exploited the finite Stokes shift as a tool for achieving optical gain threshold in sub-single exciton regime ($\langle N\rangle < 1$) in quasi-type-II CdSe/CdS@Cd1-xZnxS core/crown@gradient-alloyed shell (C/C@GS) CQWs, which presents an important step towards the evolution of semiconductor CQW lasers. In addition, these core/crown@gradient-alloyed shell CQWs offer a promising solution for the suppression of the Auger process with their smooth confinement potential. Our team demonstrated an exceptionally low stimulated emission threshold of ~820 nJ cm^{-2}, corresponding to an average number of e–h pairs of 0.84 per CQW, which is also fully supported by nonlinear absorption measurements through ultrafast transient absorption spectroscopy. The sub-single exciton optical gain regime is also confirmed by linear dependence of the normalized absorption changes. The extremely large absorption cross-section ($5.06 \times 10{-}13$ cm^2) of Demir Group's engineered CQWs, accompanied by an extremely large net modal gain coefficient of ~1960 cm^{-1}, and a long net optical gain lifetime of ~830 ps result in such ultralow optical gain thresholds and lead to record-long stable ASE. Employing our tailored core/crown@gradient-alloyed shell heterostructures, Professor Demir and his team showed a linearly polarized single-mode lasing from a vertical-cavity surface-emitting laser enabling a record low lasing threshold of ~7.46 $\mu J\ cm^{-2}$

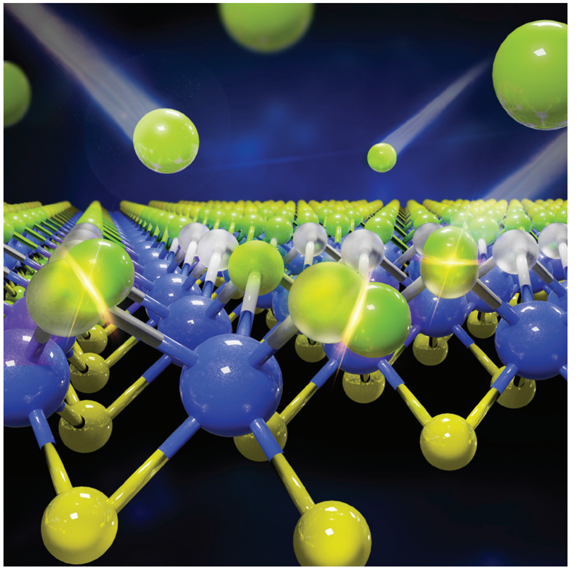
[Nature Comm. 2020, 11, 3305 (Nature Index Journal)].

Computational Nanoscience

Grubumuzda fizik, kimya ve malzeme bilimi alanlarını bir araya getiren çok disiplinli hesaplama bilimi üzerinde çalışmalar yapmaktayız. Dünya çapında önem arz eden kritik problemleri çözmek için en üst seviyede modelleme ve simülasyon uygulamalarını kullanmakta, üstün özelliklere sahip yeni malzemeleri öngörme ve tasarlama çalışmalarında bulunmaktayız. Araştırmalarımız genel olarak iki-boyutlu nano-yapılar, ve yüksek termoelektrik performanslı ultra-ince sistemler üzerine yoğunlaşmaktadır.

Two-dimensional (2D) Materials

Following the synthesis of single-layer graphene and demonstrations of graphene-based devices, 2D materials have become the focus of both experimental and theoretical studies. Unusual quantum effects provided by the reduction of dimension of the bulk materials to 2D form would bring very important innovations in already existing technologies. In this framework our main goal is to design and functionalize these novel systems and predict their possible applications.



Currently, we are working on the new-generation 2D materials composed of three components (ternary), as well as discovering the structurally stable phases, characterization of their fundamental properties, and unveiling superior features. These results will determine the potential uses of these materials in advanced technological applications. This new class of Janus 2D materials comprising various combinations of three different elements will pave the way for realizing numerous new materials; with symmetry breaking and superior properties compared to other 2D systems.

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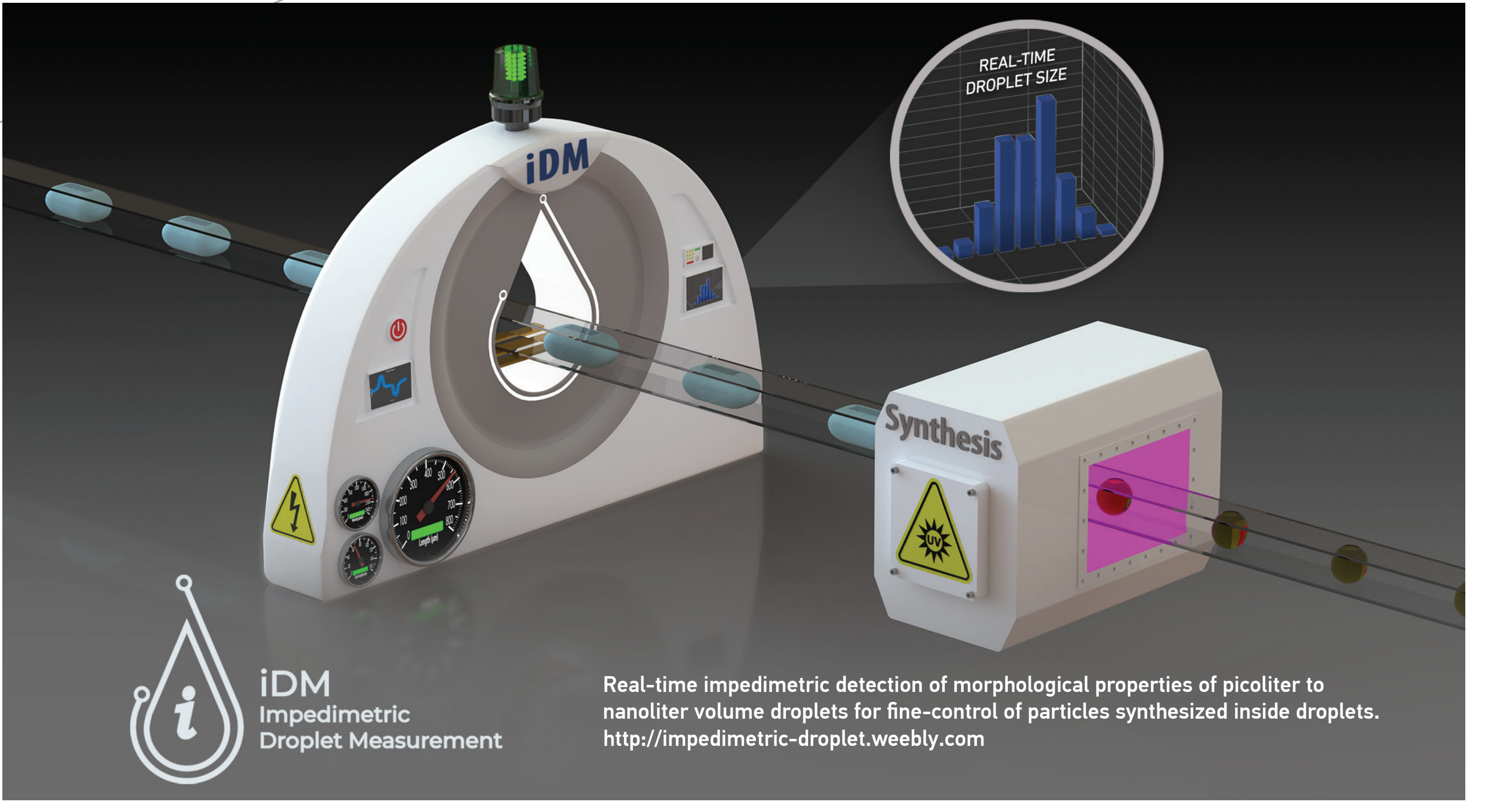
Research interests: *Hydrogen storage, 2D ultrathin material systems, solar-thermal fuels, cement chemistry, ferroelectric and multiferroic materials*

Thermoelectric properties of ultrathin systems

Thermoelectric effect is defined as the conversion of temperature difference directly into electrical potential, or in a similar manner; the creation of difference in temperature by the electrical potential. Materials featuring substantial thermoelectric properties can be utilized in energy transformation (heat to electrical energy) and cooling applications. A significant portion of the energy used up for various reasons all over the world is being wasted in the form of heat, causing problems such as excess energy costs and global warming. Reusing wasted heat through thermoelectric materials could serve as an efficient method for cost-effective solutions of the increasing energy requirements, global warming and environmental pollution. Moreover, thermoelectric devices can be utilized for cooling problems in small integrated circuits. Highly efficient, integrable and cost-effective materials are needed in order to exploit thermoelectric effect in practical applications. However, increasing the thermoelectric efficiency is not a trivial task. Among new approaches that may overcome the classical limits, nano-sized materials have been proposed with promising results being obtained. Stemmed from this motivation, we are investigating and synthesizing various ultrathin systems to achieve high thermoelectric efficiency.

Today, we are able to descride the behaviour of atoms and molecules in quantum world with computer simulations.



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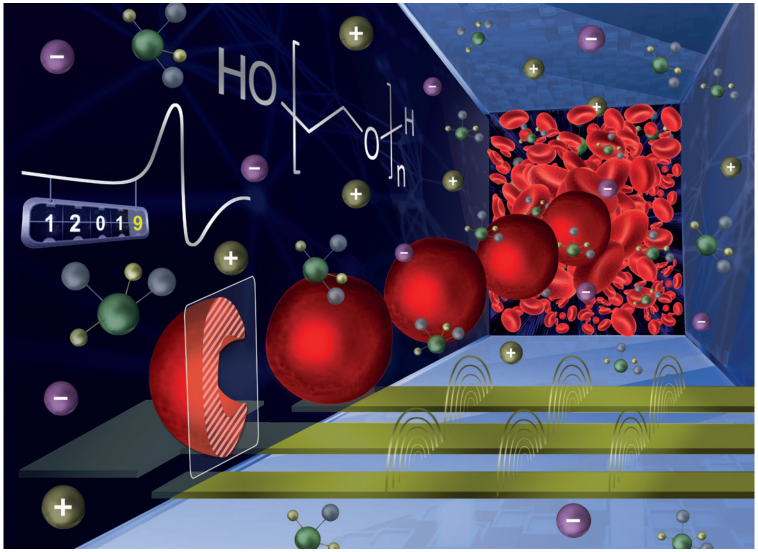
Research interests: *Microdroplet-based microfluidic systems, integrated microfluidic systems*

Micro/Nanofluidics and Lab-on-a-Chip Systems

We are working on fundamental understanding and applications of fluid flow at small scale. We are specifically interested in control of liquids with extreme precision for biochemical applications. Our research is divided into three themes: Droplet fluidic systems, viscoelastic fluids and hemorheology. In droplet fluidic systems, exquisite control of picoliter volume fluid packages enables high throughput studies using minute amounts of samples. Such systems address a broad range of applications. We explore applications in particle synthesis and single cell studies. In 2019, we have demonstrated that using an impedimetric detection system we can measure the droplet physical parameters and form monodisperse polymeric particles at a desired monodispersity (Lab Chip, 19, 3815-24, 2019). This real-time measurement capability allows on-demand particle synthesis with a pre-set size distribution (impedimetric-droplet.weebly.com). Additionally, we are working on droplet generation dynamics to achieve monodispersity that is close to the theoretical limit dictated by multi-phase flow mechanics. The improvement of droplet monodispersity reflects itself as an improvement in precision of all the assays performed using drop fluidic systems. Our latest results reveal that we can obtain world-record monodispersity values (CV < 0.2%) using pressure-driven droplet fluidic generators.

Viscoelastic Fluids and Micro/Nanoparticle Migration



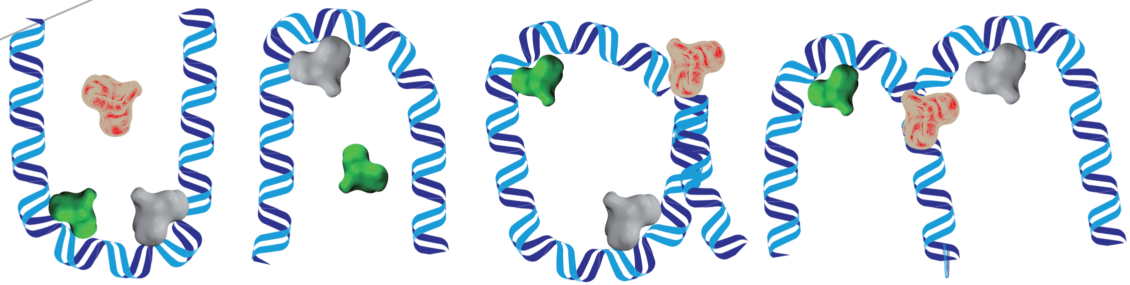
We are working on the intricate flow properties of viscoelastic fluids, which are very commonly used in our life. We are interested in the rheological properties of viscoelastic fluids and the behaviour of micro/nanoparticles suspended in such fluids. The interaction of the fluid with the shear gradient in the channel leads to intriguing particle migration behaviour. In 2019, we have shown that viscoelastic fluids can be used for focusing of microbeads and blood cells inside microfluidic channels, which is crucial for optical or impedimetric flow cytometry systems. More interestingly, we have shown that non-spherical cells, such as red blood cells, can be focused at the center of the microchannels in a single orientation using viscoelastic lift forces. This allows detection of red blood cells anomalies based on deformation and size variation using cytometry systems (Electrophoresis, 40, 906-13, 2019).

We have also demonstrated the coupling between electrophoretic forces and viscoelastic lift forces that we coined as electro-viscoelastic migration (EVM). We are working on a unifying EVM theory explaining the particle migration behaviour in simultaneously applied pressure driven flow and electric field. This theory explains the particle migration behaviour in most Newtonian and viscoelastic solutions. Using EVM, cells, polyelectrolytes, DNA, biopolymers, and proteins in complex medium such as whole blood or biological serums can be precisely focused and separated according to their charge and polymeric as in electrophoresis or chromatography applications.

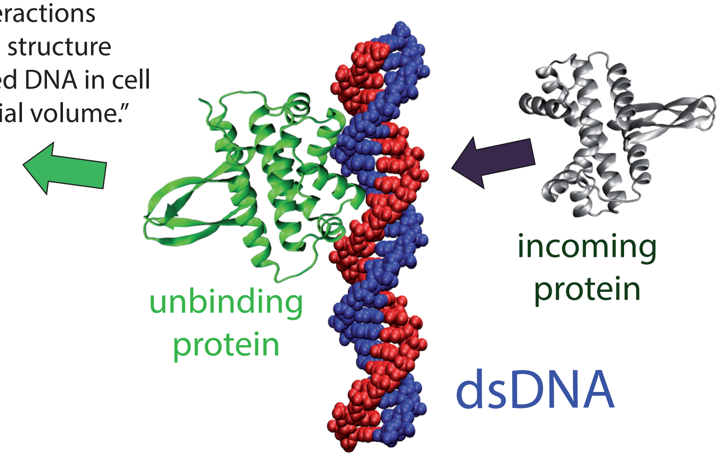
Hemorheology and Point-of-Care Diagnostics

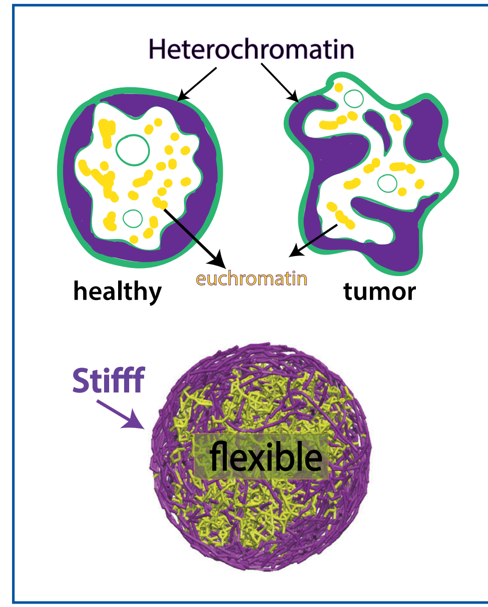
Another research line in our group is rheological properties of blood and development of novel point-of-care diagnostic devices. Hemorheology investigates blood flow characteristics determined mainly by red blood cell (RBC) deformation, RBC aggregation, and blood viscoelasticity. These properties are intricately interdependent and a complete hemorheological analysis necessitates multiple benchtop devices, some of which are not available even in high-end medical centers. Consequently, hemorheological measurements are rarely, if not at all, conveyed in clinics. We are working on the development of a novel optofluidic method for simultaneous analysis of hemorheological properties from 50 µl undiluted blood in a few minutes. The assay differentiates hemorheological differences of blood by optically investigating collective RBC movements using a handheld analyzer and disposable cartridges.

We have also devised a prototype for rapid detection of newborn jaundice using optical total serum bilirubin detection from 10 µl of heel-prick blood. Jaundice is a critical condition especially for premature births, although it is also commonly seen in term births. Preemies have less than 200 ml of whole blood which needs to be sampled for monitoring their health conditions. Therefore, every single drop of preemies blood is invaluable. In the current practice, monitoring of jaundice level is performed either by costly and time-consuming laboratory analysis, which requires high sample volume or using transcutaneous measurements sacrificing precision. We have developed a handheld system which integrates on-chip plasma separation and provides laboratory quality results in 2 minutes. The system works very similar to point-of-care glucosemeters; it is composed of a user friendly analyzer with single use cartridges. The system is licensed to Ertunc Ozcan A.S and currently clinical tests are being performed at neonatal units.



"Protein-DNA interactions determine the 3D structure of double stranded DNA in cell nucleus or bacterial volume."





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Research interests: *Statistical mechanical and thermodynamic description of soft matter, biophysics, polymer physics*

Computational and Theoretical Soft Matter

What is common between the DNA carrying your genetic information from generations to generations and the plastic bottles you sip your water from? These "soft-matter" systems are composed of often relatively long molecular structures with diverse chemical structures that we call polymer. Polymers, whether as the constituents of a biological or a human-made system, can respond to external stimuli on the order of thermal fluctuations, such as mechanical stress, electric field, flow, pH level, or temperature/concentration gradients, etc. They can also transiently adapt geometrical constraints. While all this versatility of polymeric soft-matter, on one hand, provides unprecedented survival and evolutionary capabilities for life (e.g., compaction of meters-long DNA in your cells), on the other hand, create new opportunities to design next-generation materials and pharmaceutical solutions.

Research in our lab focuses on fundamental problems in biology and materials sciences, on which we have currently either none or limited understanding. Specifically, we study the kinetic and stimuli-responsive properties of synthetic and biological polymeric systems. Some examples are polyelectrolyte hydrogels' mechanical and electric response or kinetics of protein-DNA interactions, and their role in chromatin organization, just to name a few. In our investigations, we use Molecular Dynamics (MD) simulations both on atomistic and coarse-grained levels, along with analytical tools of statistical mechanics.

Protein-DNA interactions and their role in the 3D structure of genome

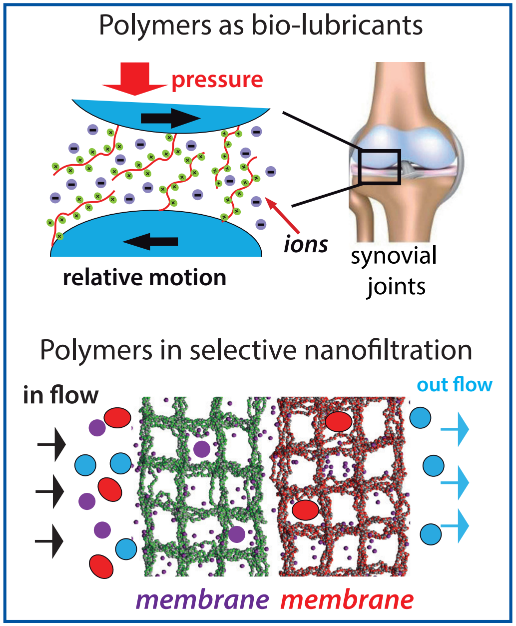
In all mammalian cells of (e.g., human cells), the meters-long DNA molecule can squeeze into a micro-meter scale cell nucleus. Typically, a more compact form of the DNA (i.e., heterochromatin) resides near the interfaces of the cell nucleus, whereas, in other nuclear locations, a less compact form of the DNA (i.e., euchromatin) is observed. The DNA can form these structures via its interactions with a vast array of heterogeneously distributed nucleic acid binding proteins and ions (monovalent or multivalent salts such as Na+, Mg2+). Strikingly, any irregularity in DNA compaction states can be traced back to DNA-protein interactions, which are also hallmark of many malignant disorders, including cancer and progeria (i.e., early aging) syndrome. In our research, by considering the polymer nature of the negatively charged DNA molecule, we would like to quantitatively model the "phase" segregation of DNA by borrowing arguments from physics of polymers and self-assembly. Our ultimate goal is to decipher the fundamental mechanism of DNA organization in confinement, thus, resolve unknowns of mechanochemical aspects of diseases mechanisms.

Stimuli-responsive polymers

Biofriction; Biological systems are good at handing friction under extreme conditions; For instance, every time a human jumps and lands on her feet, synovial tissues in knees endure pressures on the orders of mega pascals while minimizing frictional forces between moving joints. Similarly, eyelids open and close with velocities on the orders of meters per second (10 m/s= 36 km/h), nevertheless, natural lubricants coating retina hinder damage and wear in healthy eyes. In these and other connective tissues undergoing relative motion, the frictional forces are reduced by glycoprotein-rich charged polymers carpeting the relatively moving mesoscopic surfaces (e.g., synovial joints, mucin layers between cornea and eyelids). These biopolymer structures (what we refer to as polyelectrolytes) optimize the dissipation and adhesion under extreme mechanical conditions, such as high pressure and velocities. However, exact friction mechanism and functionality of the biopolymer layers in these systems have not been fully revealed yet. The research in our lab investigates shear and normal-forces acting on these polymer-grafted structures. This research, on one hand, will help us understand how nature deals with frictional forces at nanoscales, on the other hand, will open new doors to propose design principles for biomimetic materials and scalable microscale devices.

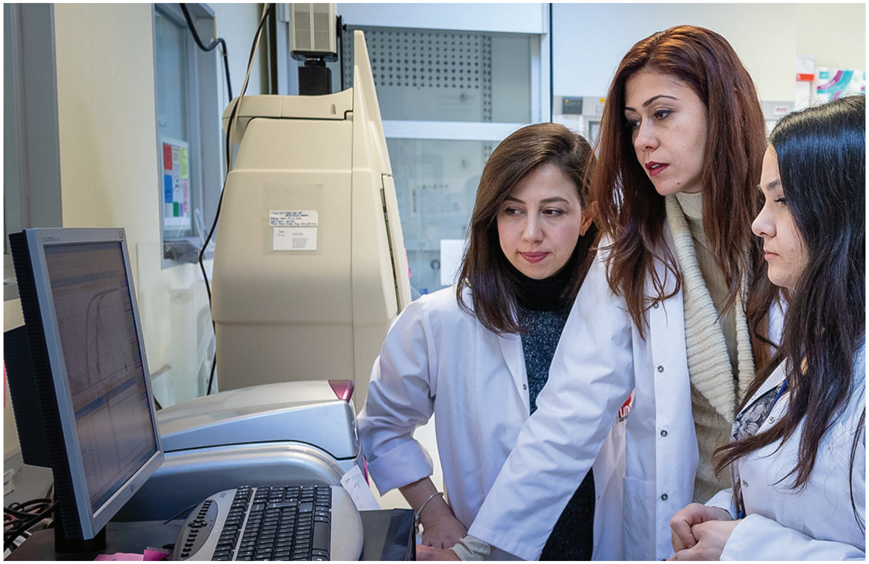
Conduction and filtration in polymer membranes

In desalination system, in which seawater is processed to obtain drinking water, or in other filtration problems such as dialysis, separation, and selection of the ionic components in a precise manner is the ultimate challenge while ensuring the reusability of filtration components. In addition, future battery applications require light-weight and cheap electrolyte materials that can allow high energy densities. Charged polymer systems can, indeed, offer solutions for both filtration and energy applications; While charged polymers can conduct ions through their heterogeneous structures, with well-defined and tailored designs, they can be used as selective membranes for filtrations applications. However, to utilize polymers in these applications, molecular-scale behavior of charged polymers to external flows and electric fields should be understood in detail. Our research aims to correlate the microscopic structure with macroscopic properties, which are of paramount interest for the engineering applications mentioned above. We would like to answer questions such as how ionic distribution increases charge-transfer efficiency in hydrogels, or how frequency-dependent external fields alter ionic correlations and propagation in polymeric media. Findings of our research will help development of modern filtration and conduction systems for energy, environmental as well as medical applications.



Novel Therapeutics and Diagnostics for Cardiometabolic Syndrome

My laboratory's research focus is at the intersection of nutrient-sensitive, inflammatory and stress pathways in the context of chronic inflammatory and metabolic diseases such as obesity, diabetes and atherosclerosis. Our goal is to identify novel therapeutic targets and biomarkers for this disease cluster. Our multidisciplinary approach includes molecular biology, chemical-genetics, RNA-sequencing, proteomics, metabolomics, transgenic mice, advanced imaging and nanobiotechnology methods.



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Research interests: *Lipotoxic endoplasmic stress, cardiometabolic syndrome, inflammation mechanics, disease modeling*

How do the excess of nutrients engage inflammatory and stress pathways in cells and lead to the development of chronic metabolic and inflammatory diseases? One clue is the chronic overloading of anabolic and catabolic organelles by nutrients leads to metabolic stress. Indeed, metabolic overload leads to endoplasmic reticulum (ER) stress and activates the unfolded protein response (UPR). We are interested in ER's unconventional mechanisms of sensing lipids and its role in coupling nutrients to inflammatory responses. Our major goal is to probe the molecular differences between the detrimental consequences of metabolic ER stress and the adaptive UPR signaling that could be therapeutically exploited in chronic metabolic diseases. The UPR consists of three branches, however, specific tools to control any of these arms are not available.

Our approach to this problem involves using chemical-genetics to specifically modulate the activities of proximal kinases in the ER stress response. This method allows mono-specific activation or inhibition of only the modified kinase in cells and tissues in vivo. This will be coupled with substrate discovery and creation of transgenic mouse models.


SERAPAK
STREÇ FILM

Micro Nano Integrated Fluids (MiNI) Research Laboratory

MiNI Lab focuses on microfluidic systems with nanotechnology applications. The flow of fluid in these systems can be either on surfaces or within channels. Recently some interesting results of surface-based systems were obtained. A new nanoparticle coating method is demonstrated by using capillary origami. In this method thin polymer membranes fold around a droplet containing nanoparticles due to capillary forces. As the droplet evaporates, nanoparticles are left on the surface. By this way, coating of surfaces with particles on folded enclosures is achieved. This work is published recently in Surfaces and Interfaces (Fig 1 & 2).

Another interesting application of surface-based microfluidics studied in the MiNI Lab is surface textured ratchets for droplet manipulation. Recently our lab showed movement of oil-based droplets on these surfaces in a controlled fashion (Fig. 3). This was a challenging work as oil droplets have very low surface tension which makes them difficult to be manipulated.

Our lab is also focusing on developing microfluidic systems for generating special nanoparticles, recently a device was developed to synthesize hybrid chitosan-iron oxide nanoparticles. These particles were synthesized by using a droplet-based flow. Results were published in Micromech. Microeng. (Fig. 4).

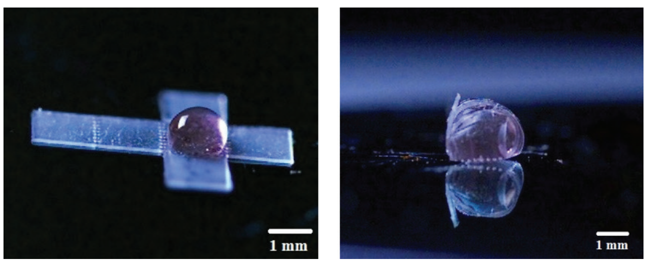

Fig. 1. Folding of a thin PDMS surface into a cubic shape around a droplet with gold nanoparticles.

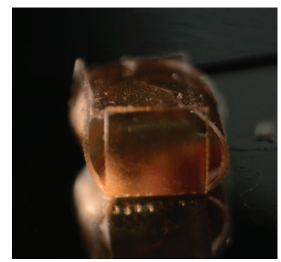

Fig. 2. Cubic folded structure containing magnetic iron-oxide nanoparticles.

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Research interests: *Microfluidic reactors and networks, MEMS, nanosensors, energy harvesting*

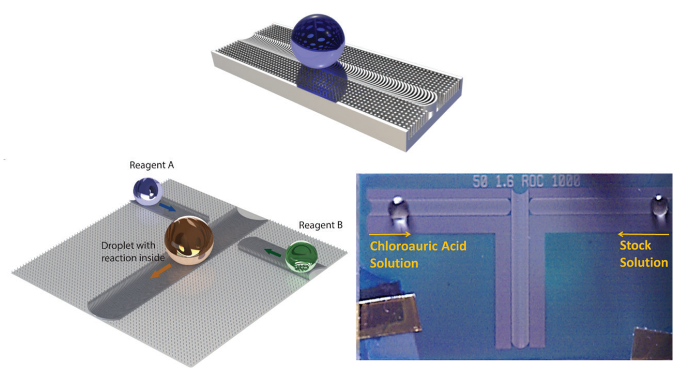


Fig. 3. Textured surfaces for droplet manipulation.

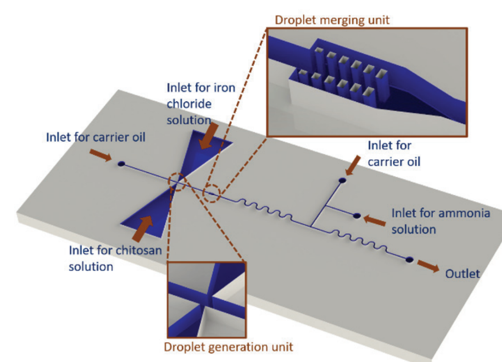
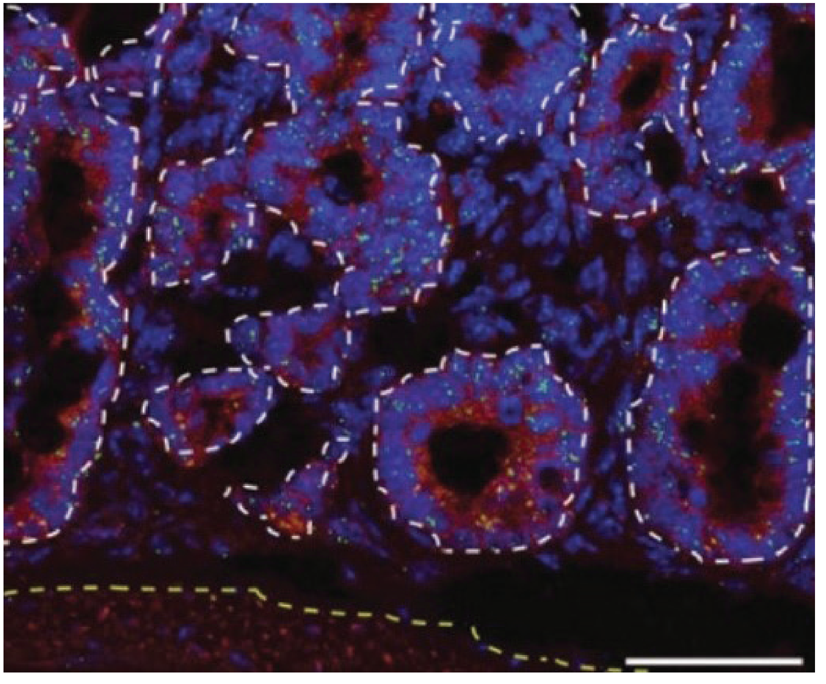


Fig. 4. Schematic of the microfluidic device for hybrid nanoparticle synthesis.

Tumor Immunology and Microenviroment



Within solid tumors cancer cells have pivotal roles in orchestrating immune reactions to create an inflammatory microenvironment that favors tumor development.

Our previous work (Greten et al. 2007, Cell; Schwitalla et al. 2013, Cell; Stellzig et al. 2013, Oncogenesis; Göktuna et al. 2014, Cell Reports; Chau and Göktuna et al. 2015, Journal of Immunology; Ladang et al. 2015, Journal of Experimental Medicine; Göktuna et al. 2016 Cancer Research) had focused on identifying key signaling pathways that regulate cytokine and chemokine signaling to direct inflammatory cell activations in mouse models of colorectal tumorigenesis. Eventually, we identified key mechanisms that regulate interactions of epithelial and immune cells which may enable us to develop therapeutic tools to interfere with tumor development regardless of stage and resistance to chemotherapeutics. Hence, we will utilize diverse mouse models of tumorigenesis together with transgenic mouse models to identify how diverse cytokine signaling pathways are regulated within different cell types in the tumor microenvironment and how these regulations affect tumor development in different cancers.

We also want to expand our knowledge on the regulation of tumor microenvironment by the microbiota to develop better understanding of their roles in disease and health.

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Research interests: *Cancer biology, gastrointestinal cancers, tumor immunology, signal transduction*

Besides, we want to develop mouse models of inflammatory bowel diseases to understand risk factors and how these diseases are connected to colorectal cancer development in different settings.

Our expertise comprises handling of in vivo samples for various disease models, generation of primary cell lines, isolation of immune cells and their characterization via flow cytometry, adoptive transplants of immune cells into host animals, various histological procedures for identifying specific phenotypes, handling colorectal cancer cell lines for various cellular assays and lentivirus based loss-of-function experiments, and almost all molecular biology techniques that will be required for basic research scientists (cloning, transfections, high or low throughput gene expression profiling, protein expression, interaction and modification studies etc.). We are also aiming to adopt recent technologies like CRISPR/Cas9 gene editing in cell cultures and in vitro organoid cultures with our future studies.

Group Members: Ugur Kahya, Zeynep Boyacioglu, Dr. Serkan Goktuna, Dr. Tieu Chau, Erta Xhafa (left to right)


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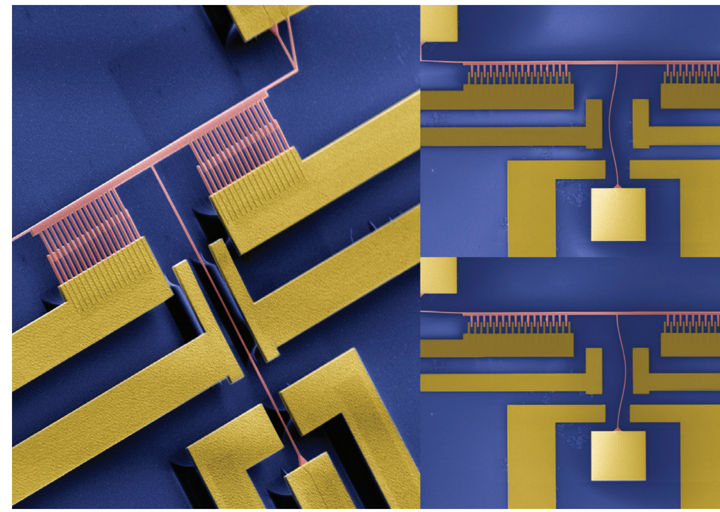
Nanoelectromechanical Systems and Microfluidic-Integrated Microwave Sensors

We work on sensing and advanced dynamics problems using two distinct family of cutting-edge technologies: Nano-electromechanical Systems (NEMS) and Microfluidic-Integrated Microwave Sensors (MIMS). With NEMS technology, we have developed nonlinear sensors capable of sizing single nanoparticles in real time under vacuum. Also, using novel NEMS devices based on buckling, we are investigating the intricate connection between thermodynamics and information processing. With the MIMS technology, on the other hand, we are developing single-cell sensors for life science applications.

NEMS

Nanoelectromechanical Systems (NEMS) are electronically controllable, submicron-scale mechanical devices used in fundamental studies as well as application-oriented efforts. The field has been under active development since the early-1990s. NEMS technology has recently begun to transform from the domain of academic laboratories into the domain of microelectronic foundries, especially within the framework of Nanosystems Alliance. It is now possible to create thousands of devices in a single process run and use these devices in sensor experiments.



Dr. Hanay has led some of the seminal experiments with NEMS sensors, for instance the detection and mass spectrometry of single protein molecules during his PhD studies at Caltech. By establishing a state-of-the-art NEMS laboratory at Bilkent University, further research projects in sensing and dynamics are being pursued. For instance, the nonlinear regime of nanomechanical sensors are usually avoided in applications: however, Dr. Hanay's group has developed a novel Trajectory-Locked Loop (TLL) to monitor a nonlinear nanomechanical sensor. With this system, gold nanoparticles have been detected and characterized one by one. This work has been published in Nano Letters in 2019.

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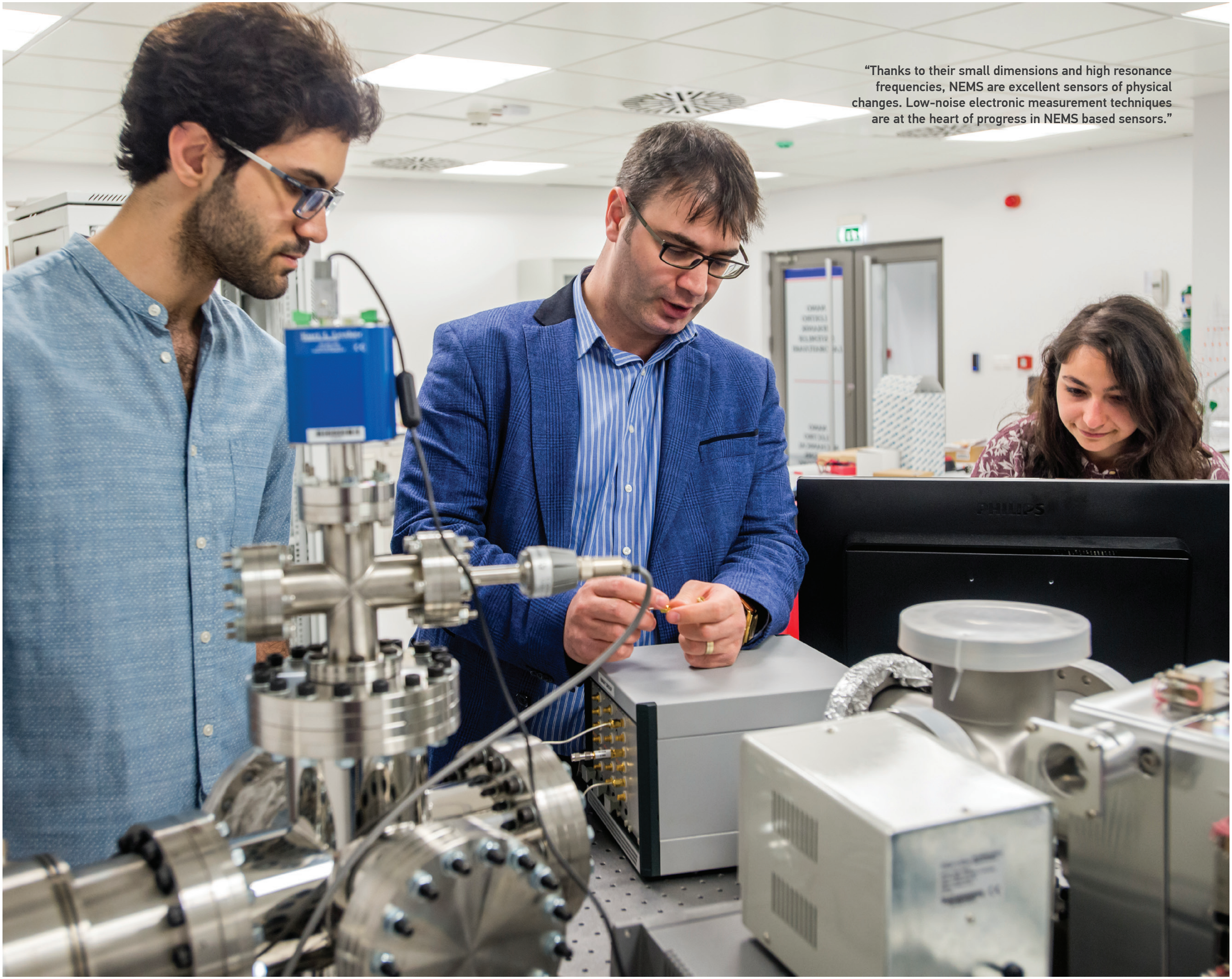
Araştırma alanları: *Nonlinear dynamics, information engines, microfluidics-integrated microwave sensors*

Another major strand with NEMS devices concerns the dynamics of information engines. The fundamental question here is the energetic cost of computation processes. The lack of precisely controllable nanoscale systems had been hindering the progress on this front. With a novel buckling based nanomechanical system, Dr. Hanay's research group demonstrated basic digital storage operations and controlled the hysteresis of device switching, a critical step for uncovering the thermodynamics of information processing. The buckling platform can also be operated as a nanoscale robotic system. This work will appear in Physical Review Letters in January 2020 and be highlighted as Editor's Choice.

MIMS

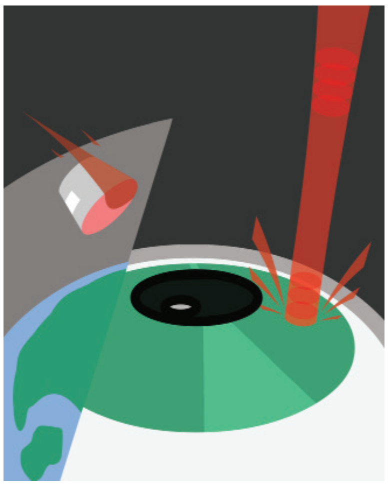
For systematic diseases like cancer, it is critical to develop personalized medicine approaches. For instance, the ability to measure the effect of each specific drug on the tumor cells of a patient is of paramount importance. We are developing novel microwave sensors integrated with a microfluidics delivery system to analyze single cells quantitatively and with high throughput. Our efforts in this field are supported by an ERC Starting Grant.



"Thanks to their small dimensions and high resonance frequencies, NEMS are excellent sensors of physical changes. Low-noise electronic measurement techniques are at the heart of progress in NEMS based sensors."

Ultrafast Fiber Lasers and Nonlinear Feedback-driven Laser-Material Interactions

The Ultrafast Optics and Lasers Laboratory (UFOLAB, http://ufolab.bilkent.edu.tr), led by Dr. Ilday, focuses on the physics of mode-locking [1] that enables the generation of ultrashort pulses from lasers, as well as pioneering the concept of nonlinear feedback-driven laser-material interactions [2-5]. Dr. Ilday was the first to propose to apply the basic concept of mode-locking to self-organized pattern and structure formation [2,3]. The commonality between mode-locking and this approach is to harness feedback mechanisms that arise intrinsically: When a laser beam modifies the properties of a material, this, in turn, changes how the next laser pulse interacts with the same material. Such two-way interactions lead to a feedback mechanism, whereby, akin to mode-locking, one only has to arrange for any desired pattern to have higher feedback gain for it to emerge spontaneously and effortlessly. This concept was later generalized to other applications, such as 3D hologram generation [4] and ultra-efficient ablation [5], achieving striking results that were previously thought to be impossible.



Ablation-cooled laser-material removal

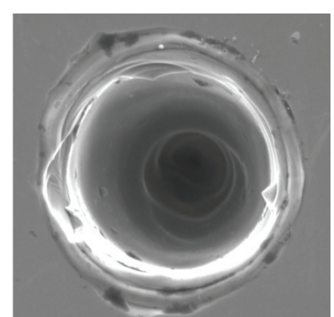
UFOLAB has recently invented a new regime of laser-material processing [5], which is accessed with ultrafast pulse repetition rates in the range of multi-GHz, in contrast to the traditional ultrafast regime using kHz repetition rates. As a result, UFOLAB has achieved 10-100 times higher ablation efficiency (volume per incident energy). At the GHz repetition rates, there is so little time between the pulses that heat diffusion becomes negligible compared to cooling by the ejection of material during ablation, hence the name, ablation cooled. This is the fundamental reason for increased efficiency. Also, instead of using 10s to 100s of microjoule pulse energy, several orders of magnitude lower energies are used. This is so because, in the ablation-cooled regime, thousands of pulses interact collectively with the material.

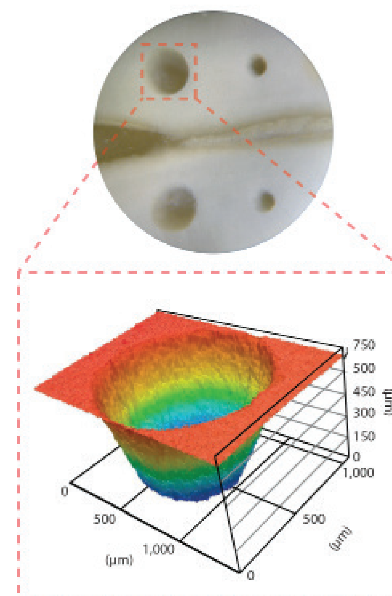
A new class of ultra-efficient high-power fiber lasers

Ablation-cooled material processing motivates a radically different laser technology, for which fiber lasers are ideal: Instead of high energies, the target becomes high repetition rates, and as short pulses as possible. UFOLAB is now pioneering the development of a novel class of ultrafast fiber lasers with an entirely different architecture and far higher wallplug efficiencies than existing ultrafast lasers.

Precision material processing with record-high speed and efficiency

The benefits of the ablation-cooled regime has been proven on a diverse and rapidly expanding set of industrially important materials, including various metals, semiconductors, heat-sensitive piezoelectric and magnetic materials, different medical implants, glasses and other transparent materials.





Ultrafast and ultra-efficient laser surgery

The most important future application of this regime will likely be laser surgery. UFOLAB has already reported record-high speeds in the cutting of brain, corneal tissue, and dentine [5]. UFOLAB is working with medical doctors to develop ultrafast and ultra-efficient laser surgeries.

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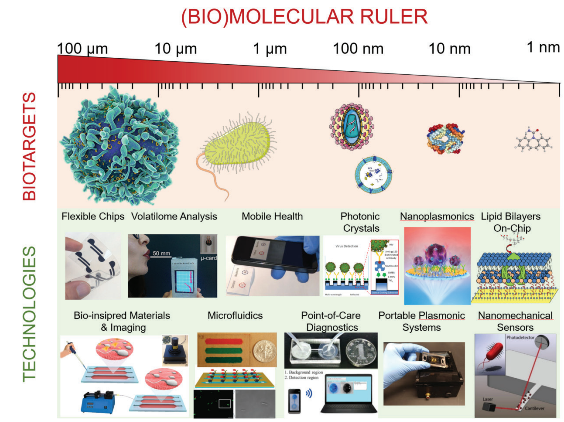
“Inspired by Nature, where spontaneous emergence of structure and functionality is ubiquitous, we aim to develop a different kind of engineering, nonlinearity engineering, based on exploitation of complex nonlinear dynamics through judicious use of intense laser beams.”

Micro/Nano-Scale Platforms For Precision Health Approaches



The future of biology and medicine lies at the intersection of materials science, nanotechnology, engineering, and chemistry. In particular, the fields of micro- and nano-scale technologies and biomedical engineering have seen an unprecedented growth and development over the last decade. Integration of innovative technologies at such small scales, termed as “disruptive innovation”, offers tremendous opportunities to address unmet needs and key challenges in medicine.

In this regard, our laboratory (Incilab) focuses on the design and development of micro- and nano-platforms to understand and investigate the fundamentals of health and disease status. Our research interest can be classified in three major areas:

Precision Health Approaches:

Health care industry is experiencing a dramatic paradigm shift from centralized-based to point-of-care (POC). Incorporating a growing number of enabling technologies with health care systems holds unique impact on delivering routine monitoring and smart health care platforms to the POC while at the same time reducing the need for skilled personnel and the cost-of-care.

In our laboratory, we harmonize microfluidics and biosensing strategies to develop disease diagnostic tools and screening tests at these settings, where individuals can easily self-monitor their health status for “precision health” applications. Ultimately, we develop mobile health approaches on a daily-basis to report disease status of individuals to physicians and caregivers, accelerating monitoring of individuals and minimizing health disparities even at the remote settings.

Bio-Imprinted Wearable Sensors:

Wearable devices are currently utilizing to screen personal analytical information, physical status, physiological parameters, as well as informing schedule for medication. In particular, precision health seeks to make health care contact more accessible by integrating monitoring and diagnostics into everyday life. On the other hand, biomarker information is a key point for diagnosis, monitoring disease progression, predicting disease recurrence and treatment efficacy. However, current biomarker detection strategies (antibody or nucleic acid-based systems) have impediments in keeping their stable structure while stuck to the body.

For that reason, we develop a “Wearable Patch” by combining molecular imprinting strategies and bio-compatible material production on the same platform. Imprinting target biomolecules and transferring their molecular structure into 3-D matrices do not only present high specificity in detection and also provide high stability in sensor performance. Integrating a biosensing unit to this platform, we analyze biotargets in situ, improving the quality of life and also providing continuous medical data for actively tracking diagnosis and treatment.

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> **“We develop cutting-edge technologies to present precise solutions for real-world problems in biology and medicine, thereby improving human health.”**

Interfacing engineering toolbox with biology:

Understanding cellular interactions requires the construction of bio-mimetic environment through conventional tissue engineering tools. Such systems, however, have some obstacles to combine physical and biological parameters at the same condition. In particular, cellular membrane proteins have key roles as they are unique sections of biological membranes, interfacing with extracellular matrix and intracellular space, as well as representing health and disease status through molecular communication mechanisms. Since they are highly produced in cells, they are major drug targets in the pharmaceutical industry. Studying with membrane proteins is challenging as they majorly contain hydrophilic and hydrophobic domains, leading to significant 3-D structural alterations in aqueous solutions.

In this regard, we aim to develop on-chip lipid bilayer systems, where many physical factors (i.e., flow and shear stress) and bio-chemical structures and agents are integrated and controlled. Such bio-mimicking integration strategies with microfluidics opens unprecedented avenues that help study the effects of dynamic forces on molecular alterations, and enable to focus on the combination of biological spatial and architectural information on cell structure/environment with the knowledge of transformation-specific alterations.

Coordination Compounds for Hydrogen Economy

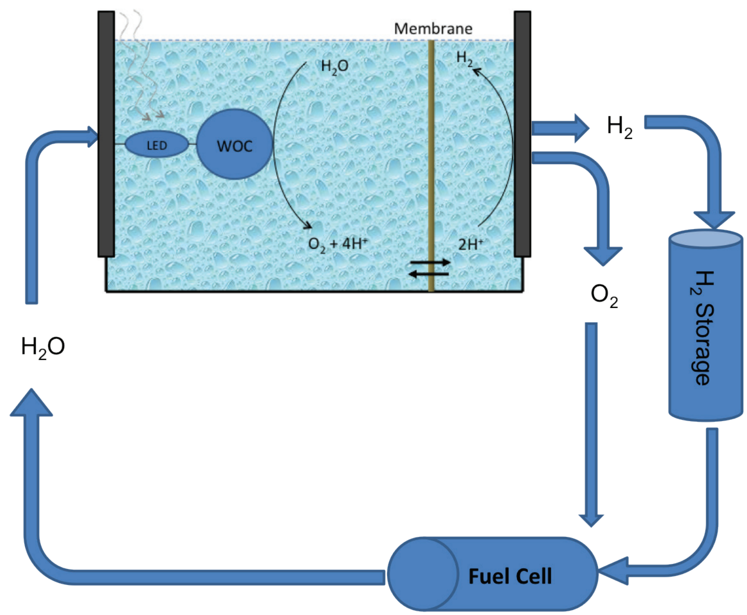
Hydrogen economy is one of the most promising candidates of alternative energy sources, which is of great importance due to limited sources of fossil based fuels and the increase in global energy demand. Two of the main challenges in hydrogen economy is water-oxidation and hydrogen storage.

Solid Adsorbents for H2 Storage
Solid adsorbents that could physically adsorb hydrogen are one of the most promising class of materials since they are robust at extreme conditions and their regeneration energy is negligible. Preparation and investigation of solid adsorbents that exhibit high performance at ambient conditions is the primary objective of our research group.

Coordination Compounds for Water-oxidation Catalysis – Artificial Photosynthesis
Water-oxidation catalysis is the most critical step in water-splitting since it is a four-electron process and requires a higher potential than hydrogen evolution step.

$2H_2O \rightarrow O_2 + 4H^+ + 4e^-$ E = 0.82 V, at pH 7

The preparation of convenient and efficient catalysts that will function in the 'artificial photosynthesis' area is one of the objectives of our group.



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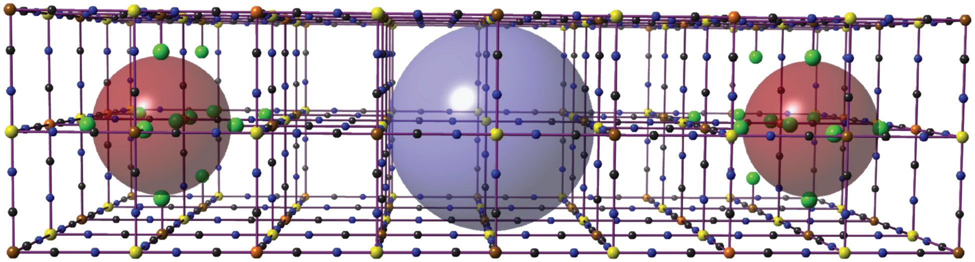
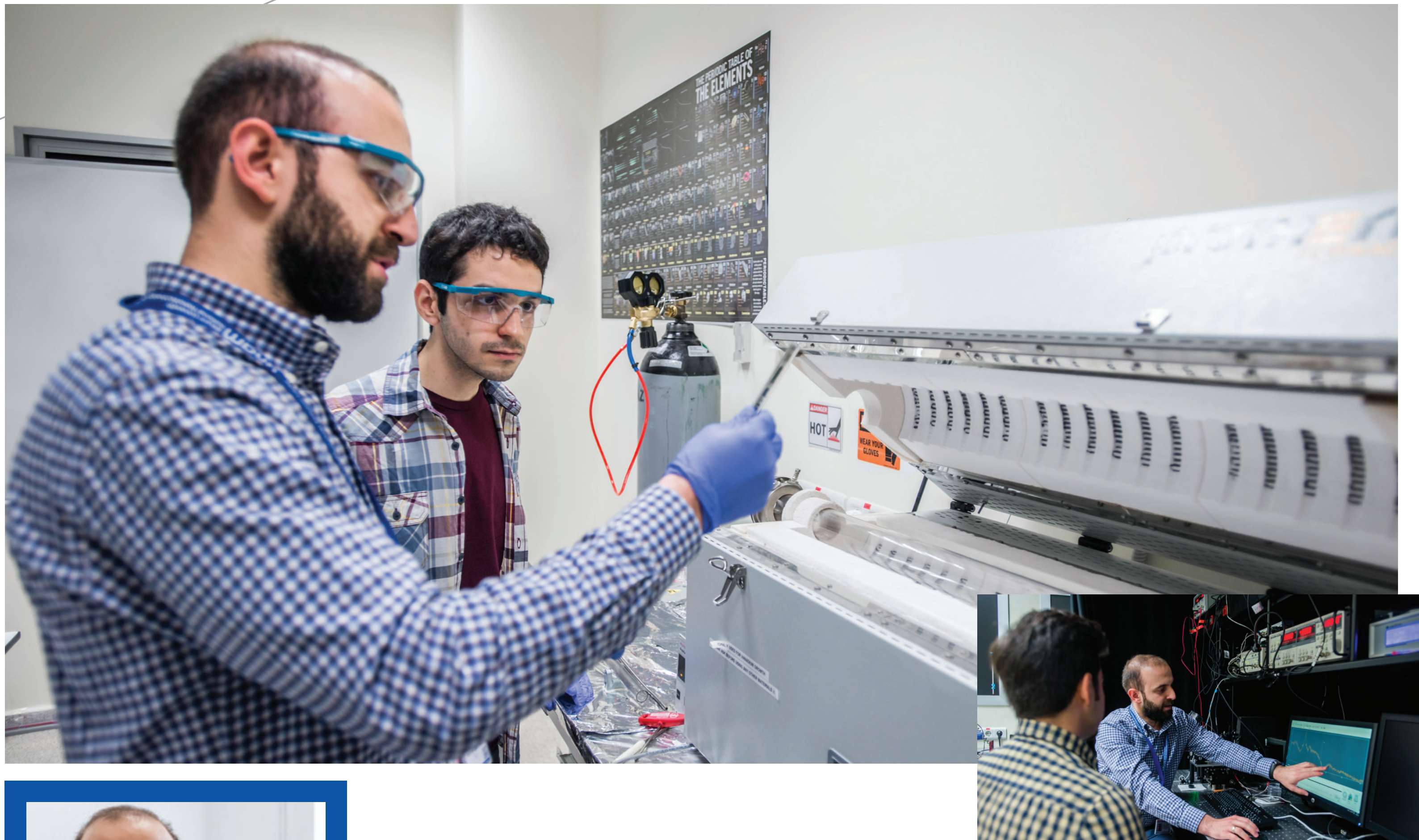
Research interests: *Hydrogen storage, Water oxidation catalysis*



Metal Cyanide Coordination Compounds
Red and purple spheres represent the vacancies inside the network.


"We are interested mainly in the synthesis and characterization of novel inorganic and organometallic coordination polymers and multinuclear molecular complexes."



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Research interests: *Strongly correlated materials, 2D materials*

Strongly Correlated Materials

Unlike the standard materials used in the semiconductor industry, degrees of freedom exist in strongly correlated materials that could significantly impact electronic and optoelectronic technology. Our research interests lie in understanding the phenomena arising from strong electronic correlations at nano-scales and employing these phenomena for novel applications. From synthesis to optical, electrical, mechanical and thermal characterization, we develop and use various tools to study low-dimensional strongly correlated materials.

Seeing the synthesis of an atomically thin layer

We built a chemical vapor deposition chamber that allows the real time observation of the synthesis of crystalline materials on various substrates. This eliminates the guessing of the parameters and enables a real time control of the growth conditions. We synthesized many novel materials including V2O3 and MnO2 using the real-time optical chemical vapor deposition. (Rasouli et al. Nanoscale 2019, Rasouli et al. PRB (Rapid Comm.) 2019)

Thermal conductivity of low dimensional correlated materials

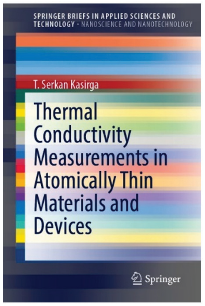
We developed a novel method to measure the thermal conductivity of low dimensional materials. The method can very sensitively and accurately measure the thermal conductivity of correlated electron materials. The measurement method we introduce is among the 5 thermal conductivity measurement methods used today for low dimensional materials. (Cakiroglu et al. 2D Materials 2020)

Mechanical properties of 2D materials

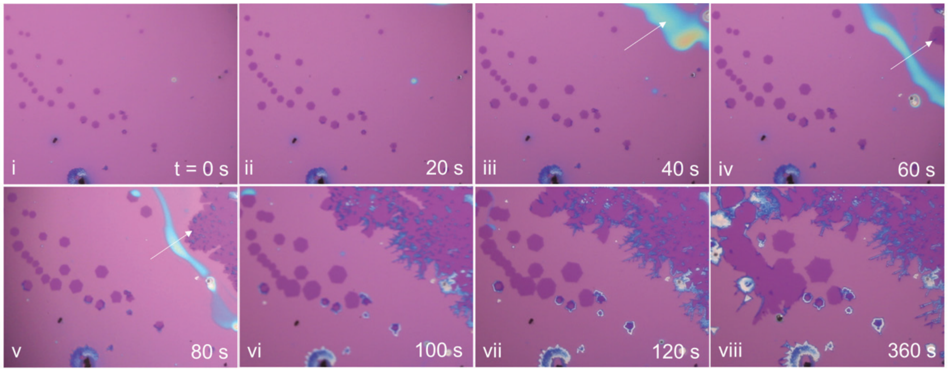
Via atomic force microscopy based nanoindentation, we study the mechanical properties of atomically thin 2D correlated materials, in particular metallic transition metal dichalcogenides. Our measurements will be published soon, and they show the peculiar mechanical properties of 2D materials

Electronics and optoelectronics of correlated materials

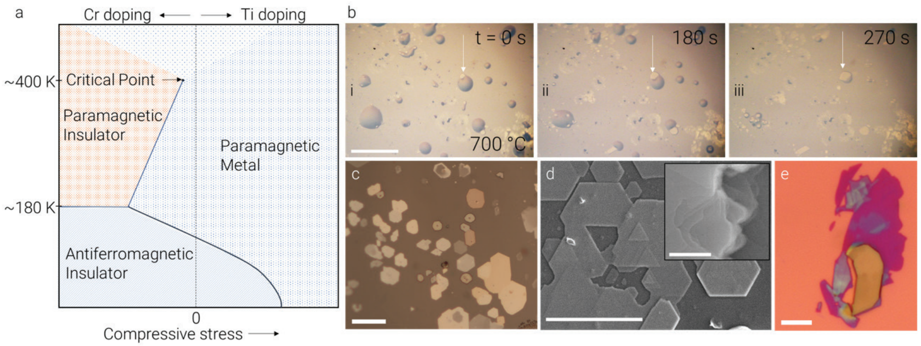
We study electronics and optoelectronics of correlated materials in the 2D limit. Among our significant results, we showed that down to a few nanometres the metal-insulator transition in VO2 single crystals persist (Fadlelmula et al. NanoLetters 2017). Moreover, NbS2 thin crystals show photoresponse due to bolometric effect (Mehmood et al. PRB 2018) similar to VO2 crystals as we have shown earlier (Kasirga et al. Nature Nano. 2012).



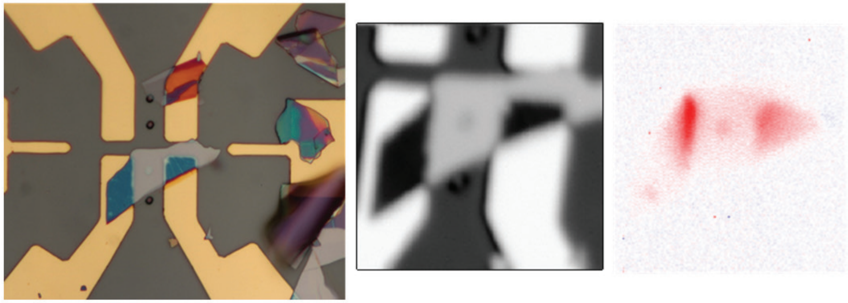
Son kitabımız atomik olarak ince malzeme ve cihazlarda ısı iletkenlik ölçümleri üzerine yayınlanmıştır.



A series of optical microscope images captured at 800 ˚C shows the growth of WSe2 atomically thin crystals. The size of each frame is 200 µm (Rasouli et al. Nanoscale 2019).



Phase stability diagram of V_2O_3 and a series of pictures showing the growth of V_2O_3 crystal.



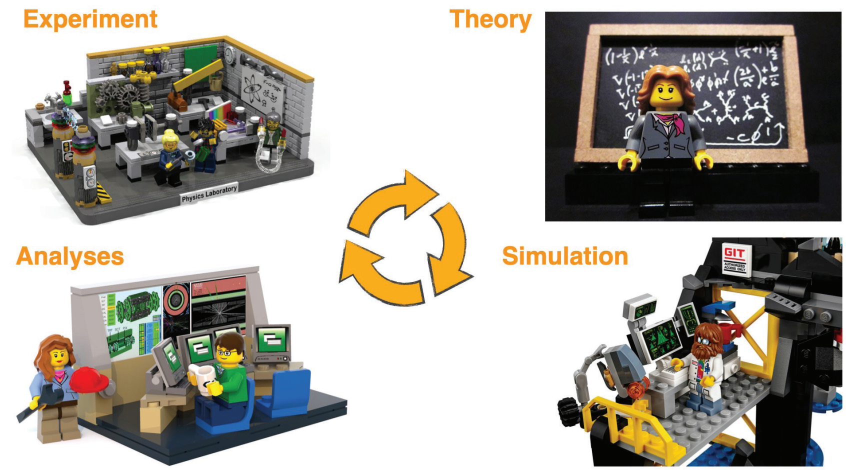
Scanning photocurrent microscopy shows the enhancement in the bolometric response of a TaS_2 flake suspended over a circular hole (Cakiroglu et al. 2D Materials 2020).

Complex Systems

Simply Complex Lab, an interdisciplinary research group of physicists, chemists, biologists, mathematicians, and engineers, was founded by Prof. Serim Ilday in December 2017. The lab conducts both experimental and theoretical research in basic science.

Our research lies at the intersection of a wide range of topics: nonlinear and statistical physics, self-assembly and organization, soft- and active-matter, mechanobiology, biophysics, applied mathematics, artificial intelligence, and nanomaterials synthesis. Although the topics are diverse, they are in line with a single goal: to understand how complex systems, i.e., biological organisms, with elegant structures and behaviors emerge from simple building blocks, such as atoms. How can we control them? Can we predict their future?

Colloids, also called artificial atoms, are our primary model system to carry out this research. We have recently shown that collections of atoms can form dynamic adaptive patterns with life-like behaviors such as self-healing, self-replication, and autocatalysis (Nature Communications, 2017). Their emergence obeys universal physical rules valid for living and nonliving systems, including 3 nm quantum dots and 15 μm human cells (Nature Physics, 2020). Even long after their dissociation, the atoms forming them stay correlated (JPCM, 2021). In this unique system, we are currently trying to understand “what is the physics of life?”. To this end, we conduct experiments, code for analysis, integrate with machine learning techniques and express our observations mathematically.



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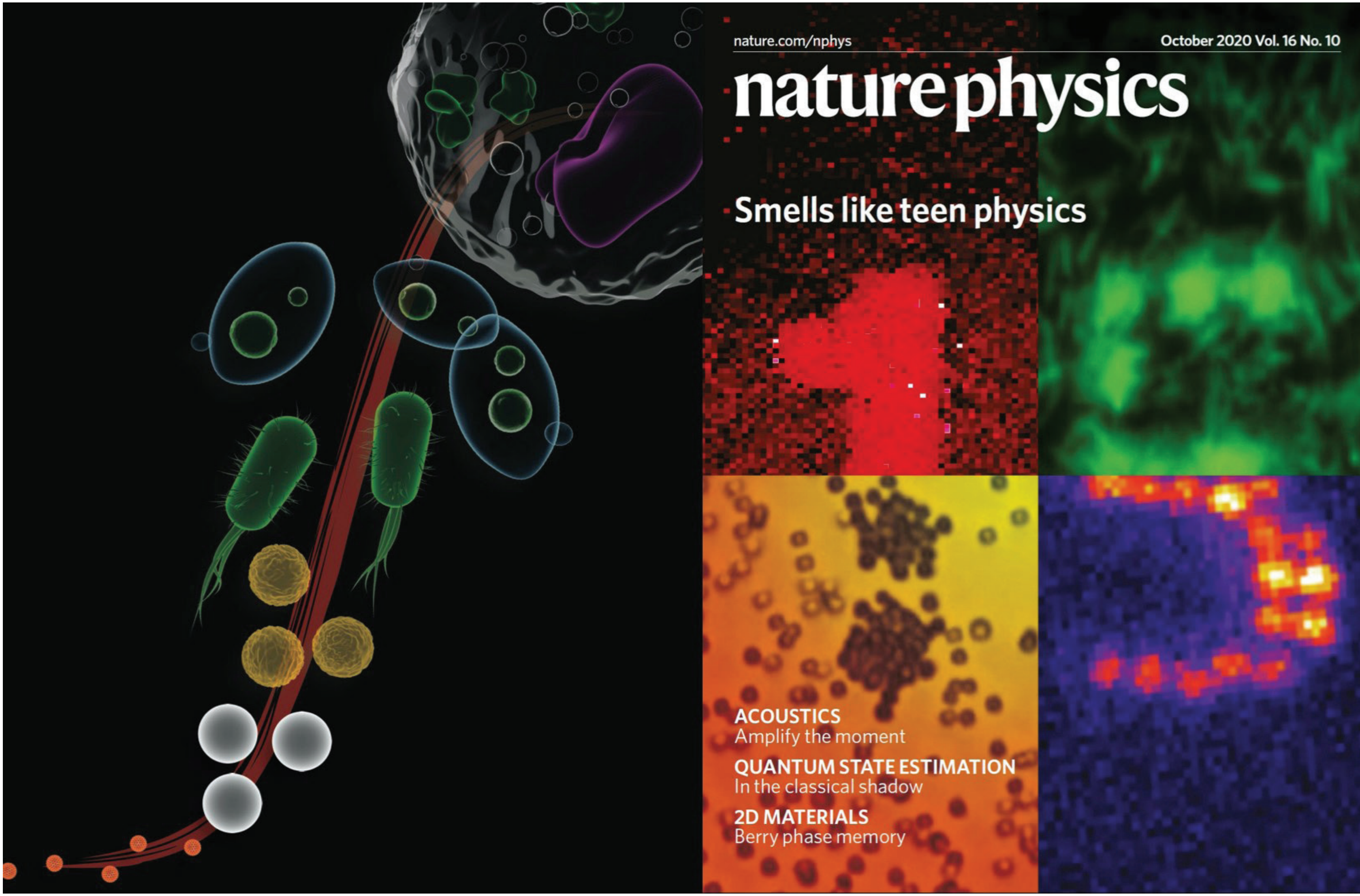
Research interests: *Self-assembly, self-organization, complexity, far-from-equilibrium thermodynamics, nonlinear and stochastic dynamics, adaptive hierarchical materials, emergent phenomena*

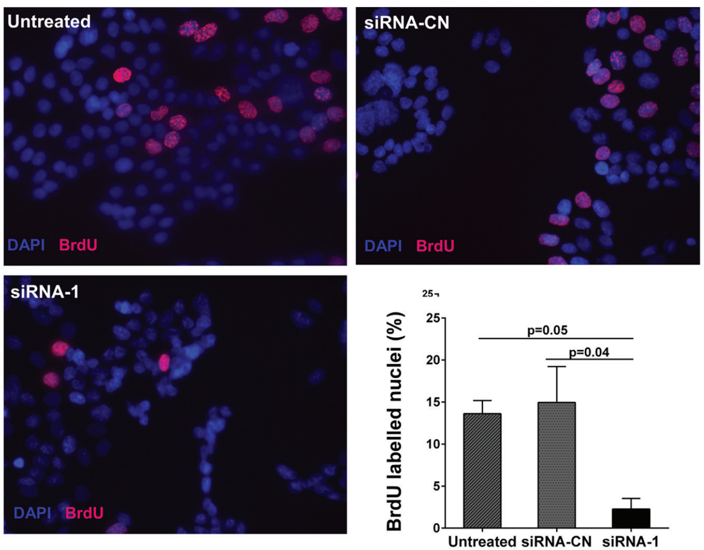
In addition to colloids, we are also using living cells as a model system. We try to understand the dynamics of emergent collective behaviors that only occur after some cells come together. We compare the behavioral similarities and differences of bacterial collections, which have sophisticated internal dynamics and evolved over millions of years, to those of colloids formed by simple, passive, identical units. By doing so, we try to find the typical emergent dynamics and mathematically express them. Furthermore, we compare the environmental adaptation processes of colloidal collections to those of cancer cells to which we apply instant physical stimuli in a dynamic environment. Based on the similarities and differences between the two, we hope to decipher the operational principles of dynamic adaptive systems. In addition, we are trying to synthesize new nanomaterials by controlling ultrafast intermediate reaction steps in chemical processes, which is not possible with current technologies.



Our work is regularly published in prestigious scientific journals, such as Nature Physics, Nature Photonics, Nature Communications, and Nano Letters, and are funded by prestigious institutions, such as European Research Council (ERC), EU Marie Skłodowska-Curie actions (MSCA), and TUBITAK. Our work has attracted considerable attention from prestigious scientific journals and the media. For details, please visit the group website: https://staff.bilkent.edu.tr/serim/

Developing Models for Studying Cancer Cell Signaling

Research in our lab focuses on developing and testing different bioinformatics, cellular and organismal models to investigate how cellular signaling is dysregulated in cancer. One of the signal transduction pathways we have been studying is cholinergic signaling. A better understanding of the role of cholinergic signals in cancer, which remains relatively understudied, can provide novel avenues for discovering effective diagnostic and treatment modalities.



Cholinergic signaling within and between cells are driven by small molecules such as acetylcholine and nicotine. Acetylcholine levels are regulated by cellular enzymes whose differential activities can be important factors in determining cancer cell's ability to proliferate and migrate. Nicotine, the addictive compound in tobacco, has also relevance since smoking is associated with the development of multiple cancers. Acetylcholine or nicotine binds to nicotinic acetylcholine receptors (nAChRs) that are pentameric in structure and made up of homomeric or heterometric receptor subunits. nAChR activation modulates intracellular calcium levels and eventually alters the rates of cellular proliferation, apoptosis, and migration, which are processes frequently altered in a cancer cell leading to tumor formation and at times, metastasis. Research in our lab is currently focused on developing effective models to understand cellular and functional dynamics of cholinergic signaling in breast and liver cancer cells. RNA interference (RNAi) is a potent technology enabling delivery of double-stranded small RNA molecules into the cell thus transiently downregulating a gene's expression. This allows for testing the effect of changes in transcript levels in the cell and discovering novel functionalities that can be beneficial in treatment of cancer.

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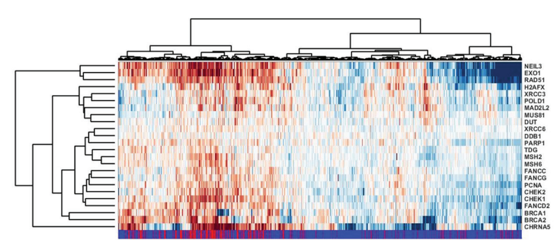
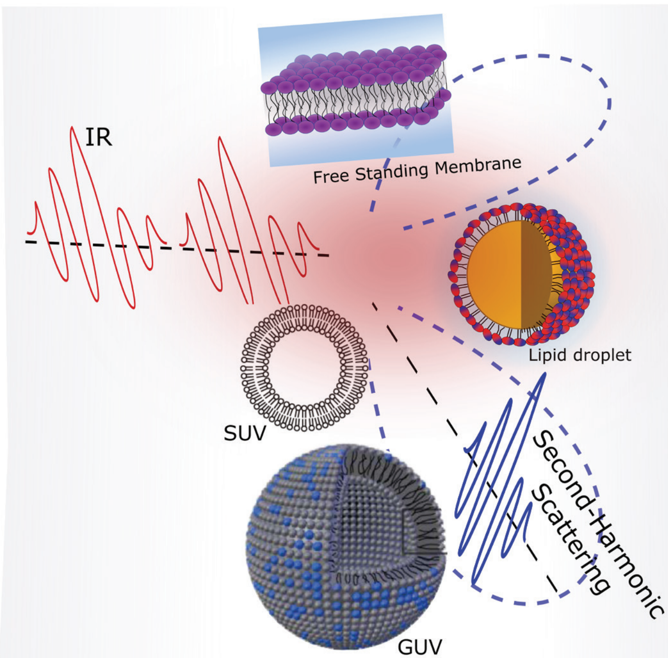
Research interests: *Bioinformatics and genomics, cellular signaling in cancer, drug screening and disease models in zebrafish*

Recently we have shown that knock-down of cholinergic receptor nicotinic alpha 5, CHRNA5, in breast cancer cells leads to reduced cell viability, and increased apoptosis and drug sensitivity using siRNA molecules against CHRNA5. This new oncogenic and drug resistance-inducing role attributed to CHRNA5 in breast cancer is currently being studied using microRNA mimics alone or in combination with siRNAs as well as in the context of other cancer types. In addition, we are interested in developing cancer models using embryos of zebrafish, an aquatic vertebrate commonly used as a human disease model. Due to transparency of embryos and availability of mutant strains, zebrafish is highly amenable for examining the genotypic and phenotypic differences of cancer cells, in vivo. Recently we have demonstrated that liver cancer cells xenografted into acetylcholinesterase mutant zebrafish embryos, which accumulate excess acetylcholine in their cells, produce larger tumors than those in the wildtype siblings. Finally, the bioinformatics field also provides important tools and resources to decipher the complexities of cancer cell signaling while helping identify the impact of RNAi treatments on the cellular state of cancer cells. We use our own as well as published transcriptomics resources in humans and zebrafish to discover novel interactions among genes and signaling pathways with importance in cancer treatment and prognostication.

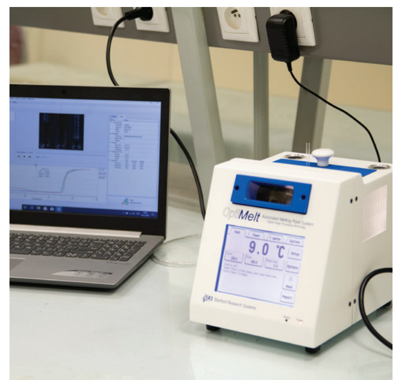


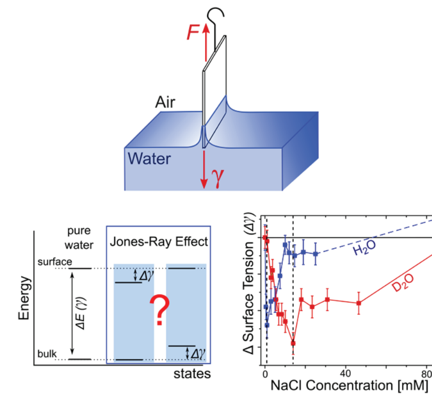

THE CELL
ALTO
EVSEL ATIK

Biointerfacial Chemistry



Biointerfaces serve as a hub for vital chemical processes. There is a delicate balance in nature to maintain the composition and conformation of these surfaces. Tiny surface modifications cause significant changes. As a consequence, understanding the molecular machinery of physiological phenomena occurring at biologically relevant interfaces is a necessity but a formidable challenge due to not having a unified methodology for all surfaces or chemical processes. In the Okur Research Group, we aim to elucidate chemical processes occurring at different biointerfaces via designing novel experiments by using nonlinear optics, spectroscopy, and modeling to reach a molecular level detailed understanding.





HALİL İBRAHİM OKUR

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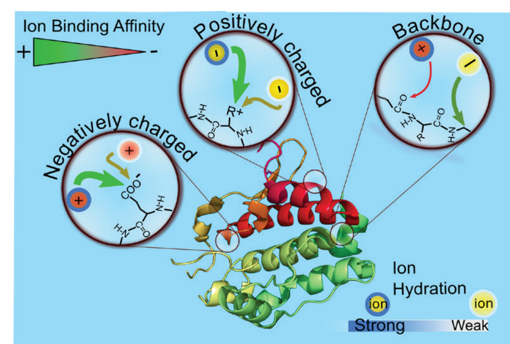
Research Interests: *Biointerfaces, water, nano-emulsions, biomacromolecules, lipid droplet organelles, specific ion effects, nonlinear spectroscopy, second harmonic generation*

Macromolecule – Ion / Osmolyte Interactions : Ions and small molecules differ in their ability to influence proteins in aqueous solution, known as lyotropic (Hofmeister) series. This series has been shown to influence numerous solution phenomena; including but not limited to, enzyme activities and protein crystallization, ion exchange, lightning, and bubble coalescence. In the Okur Research Group, we aim to achieve a molecular-level understanding and eventually predict the interactions between charged, neutral biologically relevant additives (e.g. ions, urea, sugars) and biomacromolecules.



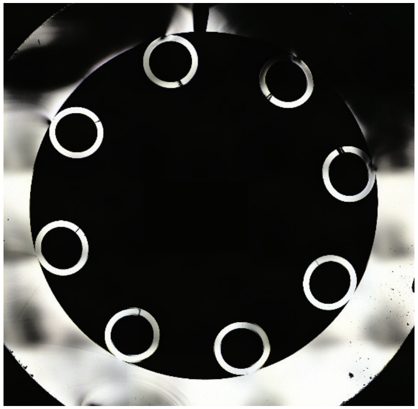

OptiMelt
10.0 °C

Infrared Fibers

In Contemporary Fiber Laboratory (CFL) we focus on developing new infrared fibers for applications in light delivery, chemical detection and nonlinear optics. Optical fibers such as hollow-core photonic crystal fibers, semiconductor-core fibers and polymer optical fibers have different optical properties in a wide spectral region. Moreover, functionalization of fibers with laser micromachining and thin film coating are effective methods to exploit their usage.

Hollow-core photonic crystal fibers (HC-PCFs)

The extraordinary optical transmission mechanism of HC-PCFs allow us guiding the light through a hollow-core for hundreds of meters. Structuring the cladding elements around the core is essential to maintain the light guidance with low transmission losses. Furthermore, the manipulation of the cross-section of the fibers with post-drawing methods such as micromachining with femtosecond lasers and thin film coating in the fibers can widen the application of HC-PCFs. In our laboratory, we are interested in developing new HC-PCFs that can be used for light transmission in the infrared spectral region. The microstructure of the fibers are designed with the help of computer simulations, and the fibers are drawn in the draw tower at UNAM. The optical characterization of fibers is done based on the design wavelength and criteria. Additionally, visible light transmission is also possible with our HC-PCFs.



A tubular HC-PCF design with eight cladding tubes

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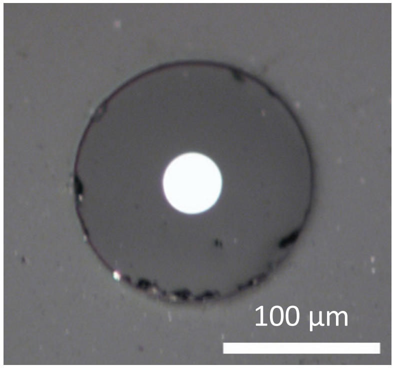
***Research Interests:** Photonic crystal fibers (PCF), semiconductor-core fibers, fiber micromachining with lasers*



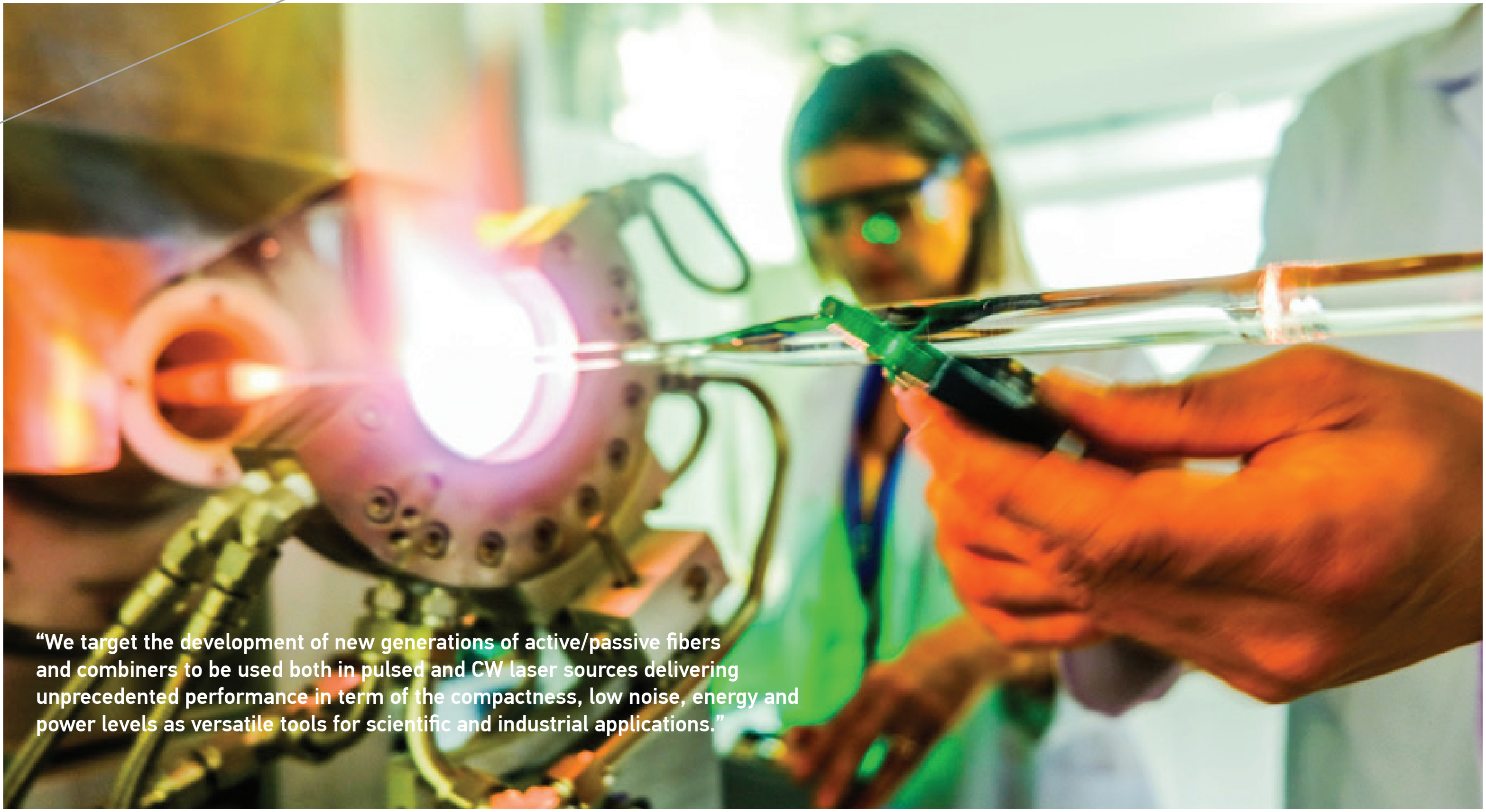
Cross-sectional view of a Ge-core borosilicate glass-cladded optical fiberOptical Mat. Exp., 2017

Semiconductor-core fibers

Semiconductor-core glass-cladded fibers have been demonstrated for the first time in the mid-2000s and have gained strong attention due to their capability of low-loss infrared transmission and high nonlinearity. In our research, we use semiconductors such as Si, Ge and Si-Ge alloys as core materials and borosilicate and silica glasses as the cladding of our fibers. The drawing and infrared optical characterization of the fibers were carried out in our laboratory. The promising results motivate us to diversify core & cladding materials to improve the optical properties of the semiconductor-core fibers.

Our ultimate goal is to integrate the semiconductors with HC-PCFs to create “Hybrid fibers” to exploit the advantages of each fiber group and develop superior fibers in the infrared region with low transmission losses.

“In CFL, drawing a variety of optical fibers such as hollow-core photonic crystal fibers, semiconductor-core fibers and polymer optical fibers forms the backbone of our research.”



"We target the development of new generations of active/passive fibers and combiners to be used both in pulsed and CW laser sources delivering unprecedented performance in term of the compactness, low noise, energy and power levels as versatile tools for scientific and industrial applications."

BÜLEND ORTAÇ
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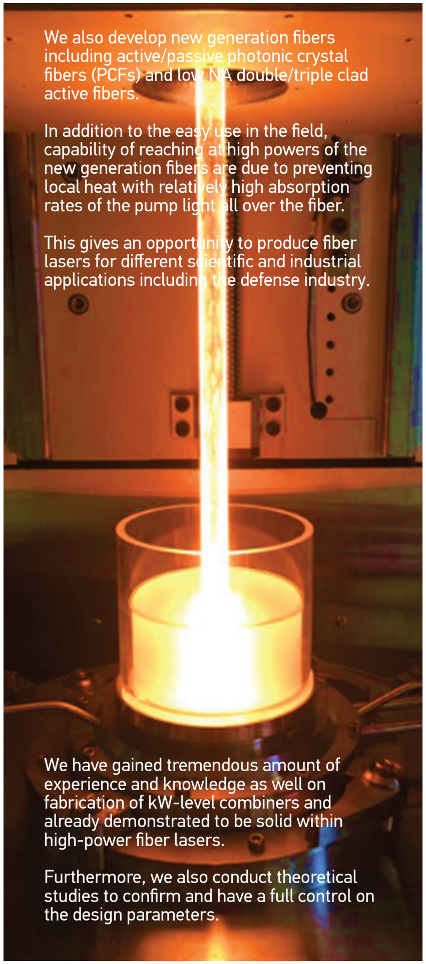
Research interests: *Fiber lasers, saturable absorbers, development of high-power fiber amplification systems*

Fiber Laser Science and Technology

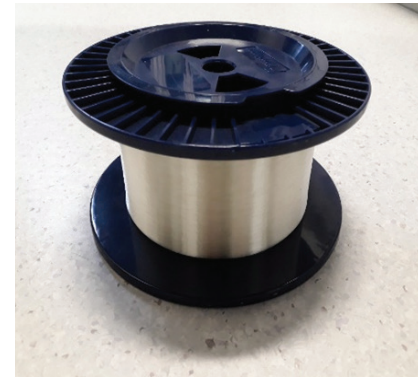
Fiber laser technology including fundamental science and various applications from medicine to industry are some of the scope of ORTAÇ GROUP. A state-of-the-art fabrication technology in house is utilized to go beyond the limits of original pulsed and CW laser sources in terms of the compactness and power levels. We focus on the Laser Science and Technology and study Pulsed-Fiber Oscillators, Fiber Amplifiers, Combining of Fiber Lasers, kW-Class Fiber Lasers, and Medical Laser Systems.

Our research portfolio covers the Fiber Technology consisting of different fiber concepts, Fiber Bragg Gratings, Fiber Combiners, Fiber Integration, Cladding Light Stripper, Polishing and End-Cap. The ongoing research activities also include investigations of laser interaction with various solid and biological materials for the formation of nanomaterials with high purity, different sizes and shapes in mass-scale.

High-power fiber lasers are important and become popular in recent years due to their remarkable characteristics. Here, we also focus on the new designs both in the fabrication process of the fibers and lasers yielding high-slope efficiency.



The mission on developing new generation of fiber lasers doped with high concentration of rare-earth ions makes us to study their unique properties by means of nanotechnology, materials science and engineering. We attempt to improve doping concentration and uniformity thus reaching at high powers with low background losses and prevention of devitrification. For this purpose, we use a Modified Chemical Vapor Deposition (MCVD) system which gives us an opportunity to obtain the glass-fiber preforms with high purity and mass-scale production. Then, the fiber preforms are drawn to the polymer coated glass fiber in our fiber drawing tower that can be operated by a capacity over 10 km within a working day. The fibers can be drawn in a way that they preserve its initial geometry and a good mechanical performance which are optimized using our recipes. We have been recognized by the Scientific and Technological Research Council of Turkey (TUBİTAK) to be the first group in Turkey of producing an active fiber which has been successfully demonstrated to operate over 1 kW laser power with an excellent beam quality. Our state-of-the art facilities allow us to characterize the fiber preforms and the fibers which get close to the commercial counterparts. For these reasons, we use throughout characterization techniques to investigate optical, elemental, mechanical and structural properties purposed to be completed with the real-time tests in the field.

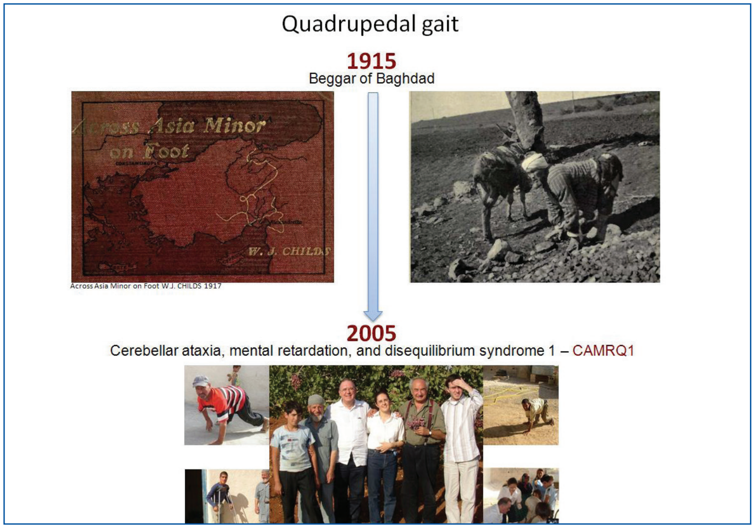


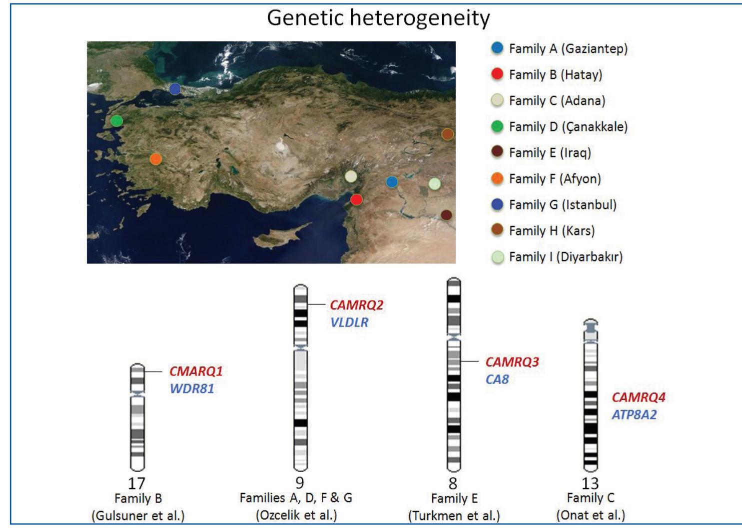
Mass Scale Production Capacity (>10 km Fiber Supply)

We also have interests in medical field as an emerging field where the use of laser science and technology increased. We do work on medical lasers and medical optical fibers designed for the endovenous laser ablation operations and a retinal laser system. The lasers are designed to operate either in visible or near infrared (NIR) wavelengths with a flexible range of energies which can be fabricated best to the needs of patients as requested by the medical doctors.

The intense research in Nanotechnology provide nanoparticles and nanomaterials which are promising for various applications including medical, biological, electronic, and industrial fields. This is due to advancement in the physical properties of the materials when reducing their size within nanoscale regime compared to their bulk counterparts. We are working on the generation of colloidal, pure and stable nanoparticles as well through laser ablation in various liquids and modification of them according to the intended use. The nanoparticle research continues with different collaborations and the research subjects ranges from sensor development to bio-medical applications.

Human Genetics and Genomics





The focus of research in our laboratory is characterization of mutations and mechanisms that lead to genetic disorders in humans. Our journey into the genome began nearly 25 years ago by determining the chromosomal localization of cloned genes in human and mouse to identify the molecular basis of inherited diseases. Also, we conducted classic linkage studies in large multigenerational families. Utilizing these approaches, we identified genes associated with Prader Will Syndrome, Charchot-Marie-Tooth disease type 1A, hereditary MLH1 deficiency and several different types of disequilibrium syndrome (Uner Tan syndrome,CAMRQ).

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Research interests: *Identification of inherited gene mutations, neurodevelopmental disorders, X-chromosome inactivation and autoimmunity, genetic predisposition to cancer*

At present, we extend our studies to complex phenotypes in humans for the identification of genes associated with obesity, extreme leanness, polycystic ovarian syndrome and essential tremors. We resort to next-generation sequencing and bioinformatics approaches to explore and annotate the human genome. In collaboration with members of the neuroscience community at Bilkent as well as scientists at Rockefeller University, Yale University and University of Washington, we design further experiments to determine the expression patterns, regulation, and function of these genes. Our ultimate goal is to understand pathophysiological processes in disease states, and to devise diagnostic tests and rational treatment strategies.

In 2014, our group continued to study complex phenotypes in humans including obesity and essential tremors. Together with Dr. Tekinay from UNAM, we identified a gene which causes essential tremor and Parkinson disease. In an independent line of research, our group studies the rate of early post-zygotic mutations in humans and uncovered that de novo variation could substantially contribute to the pathogenies of human diseases.


ANSEL
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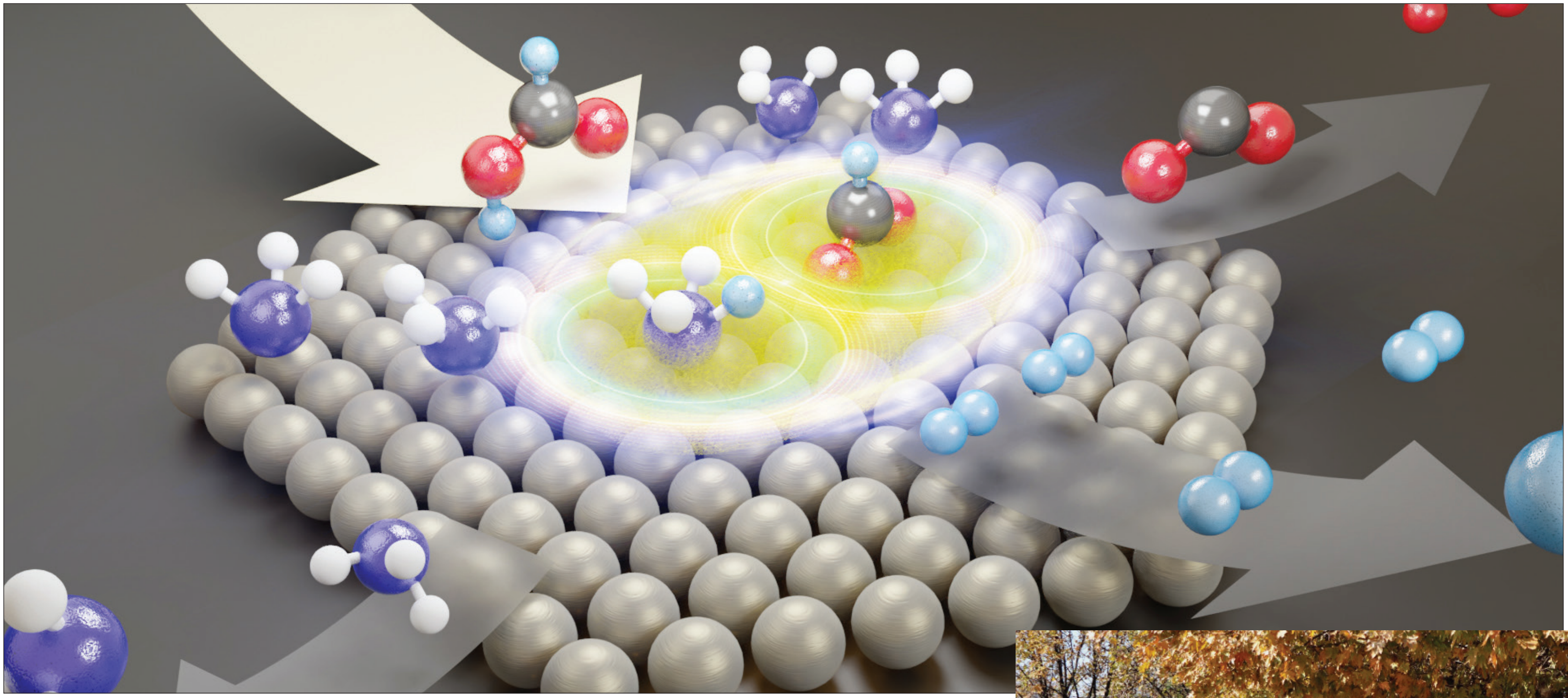
Catalysis for Energy, Environment and Sustainability



EMRAH ÖZENSOY

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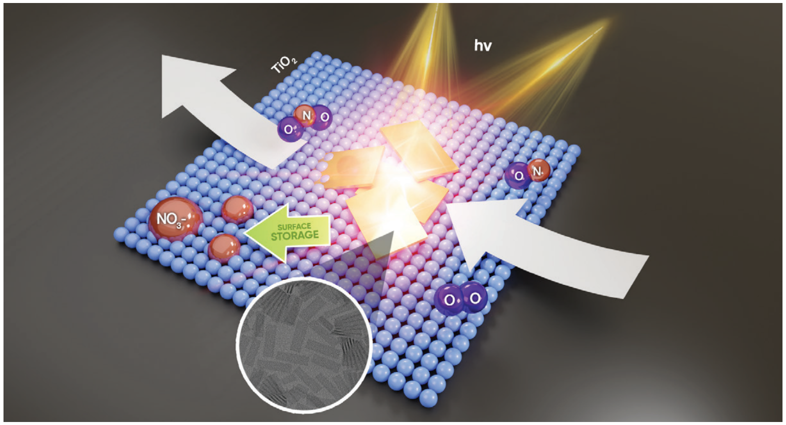
Research interests: *Heterogeneous catalysis and Photocatalysis, nanomaterials for energy storage and conversion, environmental catalysis, renewable energy systems, spectroscopy and surface science*

Ozensoy research group focuses on the investigation of catalytic nanomaterials and processes for alternative energy production, energy conversion, sustainability, environment and aerospace.

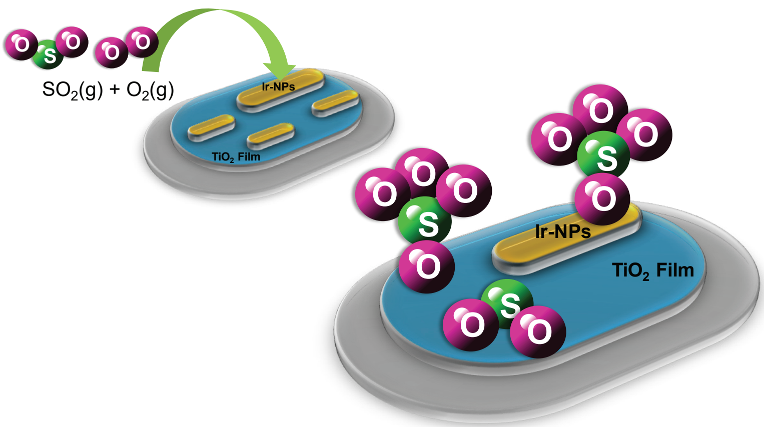
Our infrastructure is geared towards synthesis of advanced catalytic material architectures,design and utilization of custom made in-situ spectroscopic methods/techniques to elucidate heterogeneous catalytic reaction mechanisms, understanding of the structure of catalytic interfaces at the molecular level and unraveling new structure-functionality relationships. Our interdisciplinary research interests overlap with a wide variety of fundamental fields ranging from physical chemistry to chemical physics, chemical engineering and material science.

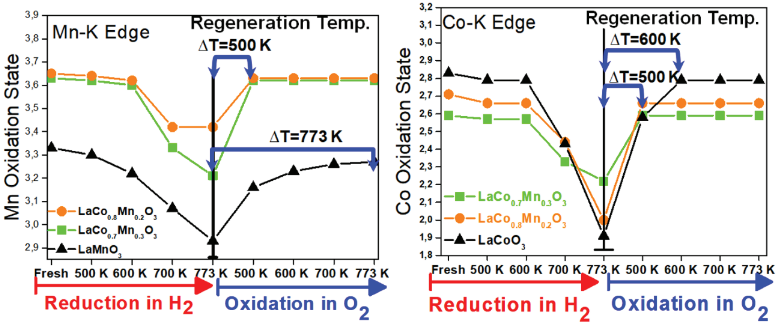
We work on the development of novel catalytic nanomaterials for efficient hydrogen production from biomass side-products, photocatalytic air pollution control/water disinfection via solar energy, valorization of bio-ethanol and its catalytic conversion to added-value chemicals, automotive catalytic converter technologies, harvesting of solar energy for chemical applications and utilization of ionic liquids in aerospace propulsion technologies.

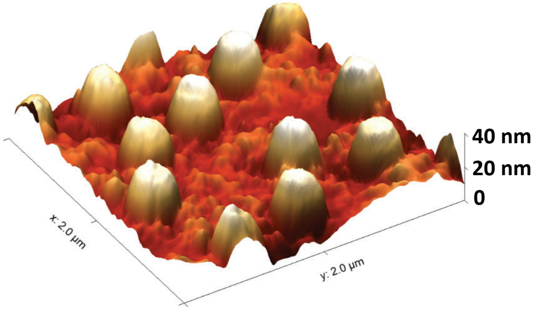
Understanding the surface chemistry of catalytic materials is challenging. Thus, Ozensoy lab addresses this challenge by using a variety of experimental and theoretical approaches. Complex catalytic systems comprised of monometallic/multi-metallic nanoparticles, mesoporous metal oxides, perovskites and zeolites are investigated with in-situ FTIR, ATR-IR, XRD, BET, Raman, TEM, EDX, EELS, SEM, ICP-MS and XPS (as well as other numerous bench-top characterization techniques available at the National Nanotechnology Research Center , UNAM). These characterization studies are also coupled to the catalytic activity/selectivity experiments which are also performed in-house using the custom-made batch reactors and flow reactors at the Ozensoy Lab.



Furthermore, catalytic reaction mechanisms are studied at the molecular level using planar single-crystal/thin film model catalysts with the help of surface sensitive ultra-high vacuum (UHV) techniques such as IRAS, TPD, LEED and XPS. These surface science experiments are also united with theoretical modeling (DFT calculations) performed by our collaborators. In addition, advanced operando measurements on the catalytic materials are performed at various international Synchrotron facilities utilizing XANES and EXAFS.





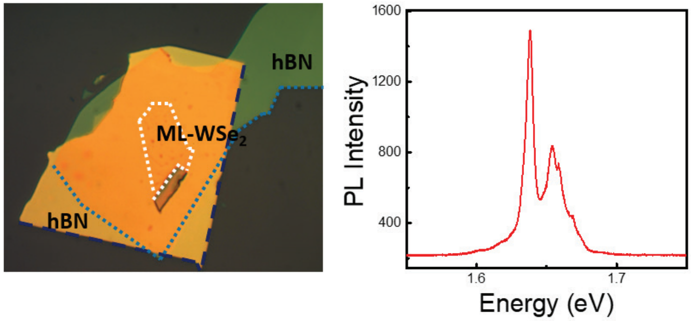


Quantum Photonics of Low-Dimensional Materials

My research group at UNAM mainly focuses on light-matter interaction in low dimensional materials such as quasi-one dimensional (1D) carbon nanotubes, two dimensional (2D) transition metal dichalcogenides (TMDs), hexagonal boron nitride (h-BN) and black phosphorous (BP). Our overarching research goal is to better understand and control light-matter interaction (by integrating emitters into different micro and nano-cavity designs) in these materials for efficient use of them in optoelectronic and quantum photonics device applications.

2D Material Based Nanophotonics:

Following the isolation of graphene in 2004, 2D material based research has gained tremendous interest among the scientific community. Although graphene has enormous mechanical, optical and electronic properties, lack of a band gap is a drawback for optoelectronics device applications where semiconductors are needed. As a complement to graphene, monolayer TMD materials with a band gaps in the visible to near infrared spectral range have been extensively studied in recent years. Due to the strong quantum confinement and reduced dielectric screening, excited electron-hole pairs (excitons) in TMDs are strongly bound. For that reason, the optical response of TMD materials is dominated by the excitonic resonances even at room temperature. The electronic band structure of TMDs makes the observation of other exciton complexes also possible in these materials. Also, the strong spin-orbit coupling and broken inversion symmetry in monolayer TMDs give rise to spin-valley coupling whereby valley degree of freedom can be used as an information carrier. **The fundamental research related to (a) photophysics of excitons as well as other excitonic species (trions, biexcitons, dark excitons, interlayer excitons) and (b) valley physics of excitons in TMDs is carried out intensively in my research group. We are not only working with TMD materials but also working with other 2D materials (BP and hBN) as well.**



2D materials and their heterostructures open up exciting new possibilities for fundamental science, optoelectronics and quantum photonics device applications.

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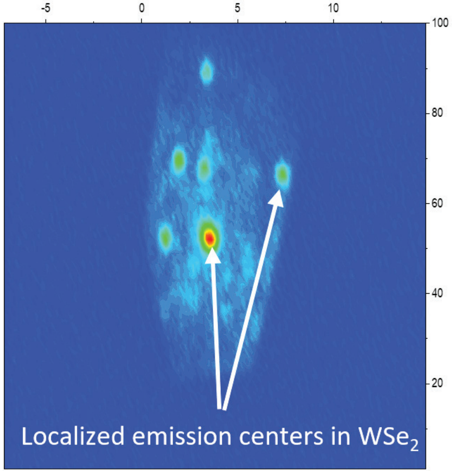
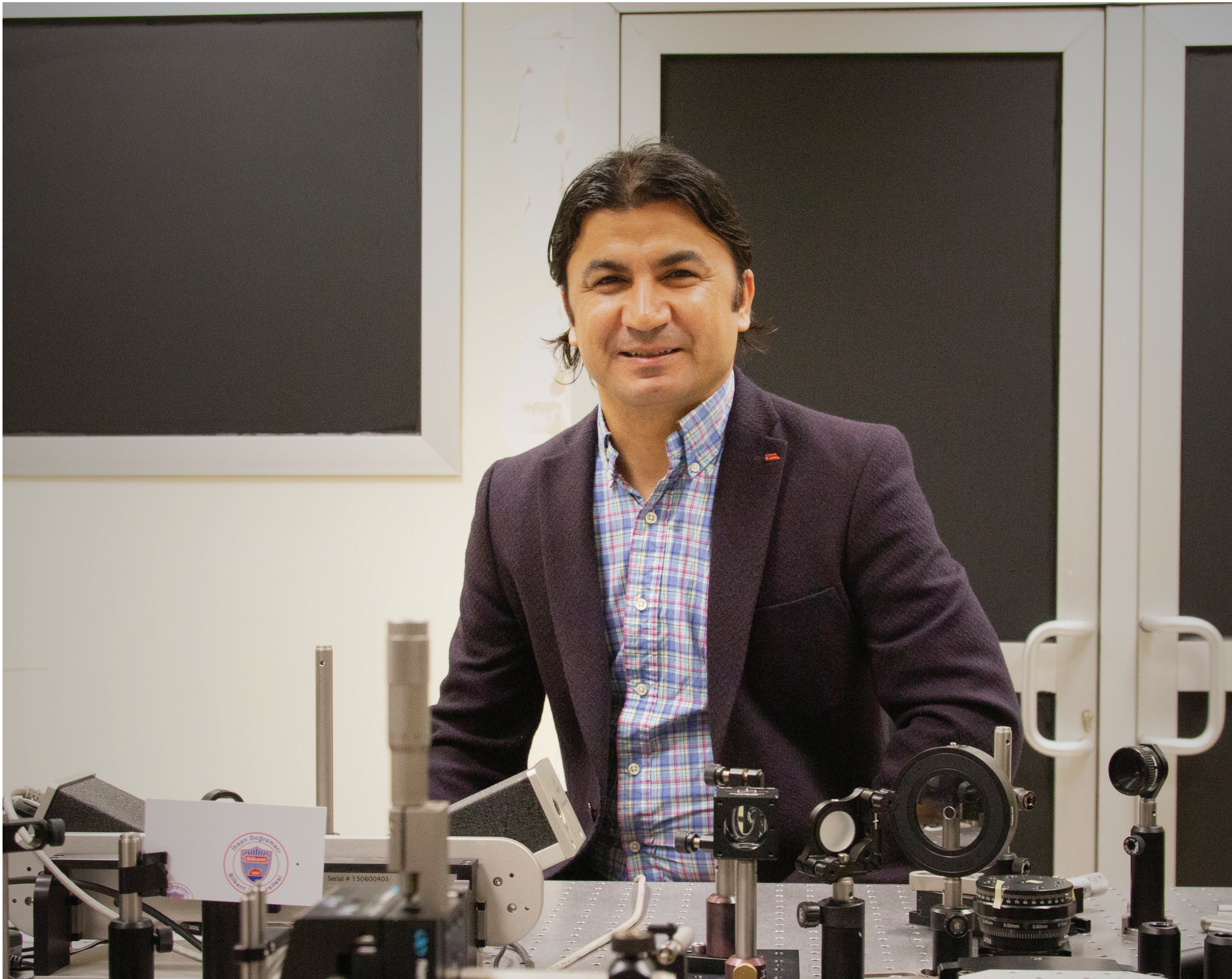
Research interests: *Carbon nanotube and 2D material based nanophotonics, experimental quantum optics, plasmonics*

Quantum Photonics with 2D Materials:

Most of the proposed applications of quantum information science require single photon sources. Delocalized valley excitons can be also trapped at defects and get localized in host TMD material. Single photon emission (non-classical light) have been observed from these localized excitons at cryogenic temperatures. Recently, color center related bright and stable single photon emission have been also observed in wide band gap hBN. In addition to high purity single photon emission, quantum light emitter must display also directional and well defined polarized indistinguishable photons combined with the high collection efficiency, which are essential building blocks of many of the quantum computing processes. **In that regard, understanding and controlling the photophysics of single photon emitters both in TMDs and wide band gap hexagonal boron nitride is another research direction we pursue in our group. Our research aims to develop, design and fabricate various micro and nano-cavity structures such as 2D planar microcavity, Open-access Fabry-Perot tunable cavity and plasmonic nanocavities to obtain efficient, on-chip scalable single photon sources based on 2D materials.**



Localized quantum emitters in semiconducting TMDs are important for device applications of quantum information science.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Synthetic Biology and Living Therapeutics

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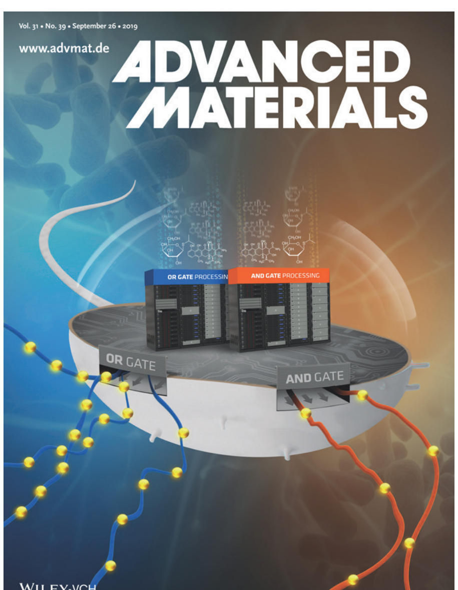
Research interests: *Synthetic biology, genetically engineered organisms biodevices, genetic engineering and protein engineering at the bio-nano interface, medical biotechnology*

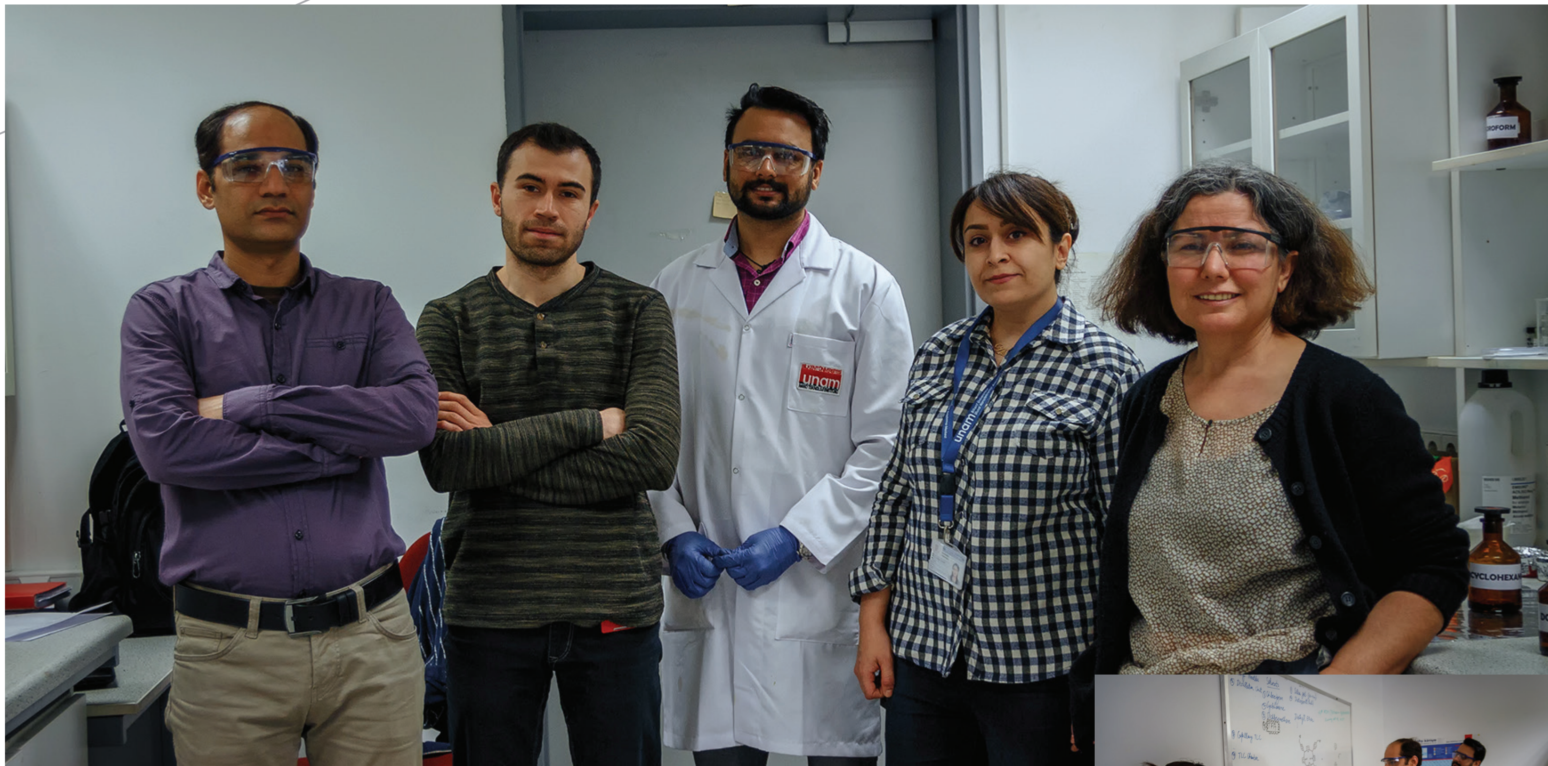
Synthetic Biology, an emerging discipline of engineering, finds its roots in chemistry, biology, physics, electrical engineering and computer science. By integrating the principles of engineering and biology, this multidisciplinary field aims to create and redesign novel biological entities. Our group is interested in designing and implementing robust genetic circuits to build whole cell sensors. These sensors will then lead to the creation of novel biocatalysis systems, and will facilitate the production of nano/biomaterials with engineered functionality. We are also interested in discovering the potentials of synthetic gene regulatory systems and their associated elements.

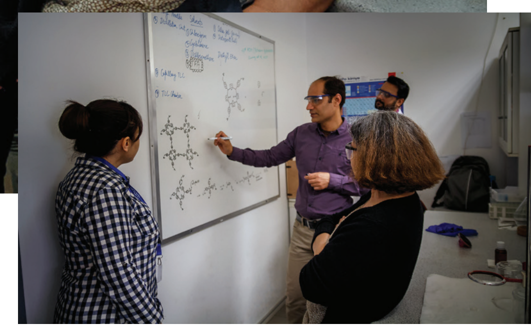
Advances in synthetic biology during the last decade, have revolutionized the fields of medicine, genetic engineering and biotechnology. The ability to design new organisms with synthetic gene expression and controlled regulations for desired functionality, has paved the way towards advanced evolutionary engineering with unprecedented applications.

Synthetic circuits are formed using genes/proteins and their regulatory elements. To form a genetic circuit, well-characterized biological parts from various organisms can be utilized. Among these are nucleic acids, genetic regulatory elements and proteins. By combining these biological parts along with logic gates, memory units, biological switches (e.g. toggle switches) and biological oscillators, several biological devices can be created. In addition, a genetic language to program cellular functions can be achieved. Therefore, all the biological devices under the control of a cellular program can be engineered to perform highly complicated tasks for a specific function.

Our current research encompasses a broad spectrum of possible applications of synthetic biology ranging from diagnosis, environmental sensing and material synthesis. Through integration and combination of different sensory elements from different organisms, design and construction of novel whole cell biosensors that can generate desired output in response to specific molecules are studied. In coordination with biosensor studies, theranostics applications are spaciously explored. We are focusing on generating therapeutic output signals by making use of genetic circuitry in whole cell biosensors. In our lab we are investigating novel theranostics solutions for diseases such as diabetes, neurodegenerative disorders, viral infections and cancer. In this context, targeted therapy is the most important highlight in solutions for cancer and viral infections. Additionally, limits of functional biomaterial production and development are expanded using enhanced biological processes such as biofilm formation and biomineralization. In this sense, to achieve our goals, novel techniques and approaches of synthetic biology are optimized and perfected such as optogenetic and logic elements in our laboratory. Novel synthetic biology techniques for disease research are developed for a better understanding of the underlying mechanisms and further information can be found in detail in our recently published papers, which also rank as cover papers in their corresponding journals. SBL group is also closely collaborating with pharmaceutical companies to develop novel antibodies and protein based drug molecules.







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Research interests: *Design and synthesis of novel organic and inorganic/ organic hybrid, nanostructured functional materials with potential applications in the areas of photonics, photocatalysis and bionanotechnology*

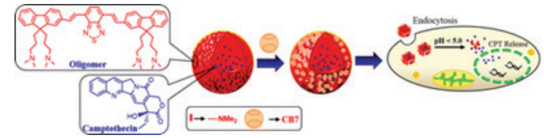
Functional Organic Materials for Advanced Applications

Our Research interests lie at the cross section of nanoscience, supramolecular and polymer chemistry. The main focus is on the design and synthesis of novel functional materials to be used in a variety of areas including photonics (e.g. light emitting diodes, colour converters, solid state lighting, photovoltaics, lasers and plasmonics), nanomedicine (e.g. drug delivery, vaccines, imaging, therapeutic agents) and photocatalysis. To this end, we design and synthesize materials in the form of supramolecular stimuli responsive assemblies, polymeric materials or nanomaterials depending on the application in mind.

Light emitting functional conjugated polymers and nanostructures:

We design and synthesise a number of different useful functional groups containing conjugated polymers and oligomers and exploit their applications in the areas of optoelectronics and photonics as well as nanomedicine. These oligomers and polymers can also be converted into water dispersible, stable nanostructures in the form of nanoparticles, vesicles or capsules in various sizes by tuning the reaction conditions. Depending on the structure and functional groups that oligomer and polymers carrying, these nanostructures can be pH, redox or light sensitive.

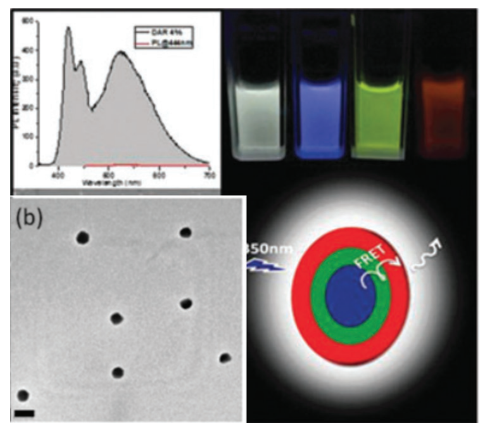
These tailor-made materials could include many interesting features and functionalities and could be designed to display unprecedented properties. For instance, they may be intrinsically fluorescent, and/or act as a photosensitizer to generate reactive oxygen species, to be used in the antibacterial and photodynamic therapies as well as they may combine more than one therapeutic agents for multi modal therapies, e.g. chemo, photo and photothermal therapies.



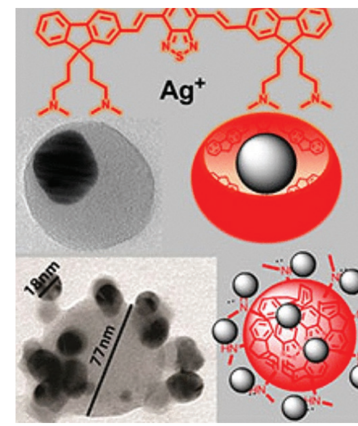
Red Emitting, Cucurbituril-Capped, pH-Responsive Conjugated Oligomer-Based Nanoparticles for Drug Delivery and Cellular Imaging, Biomacromolecules, 2014, 15, 3366-3374.

Hybrid organic-inorganic nanostructures:

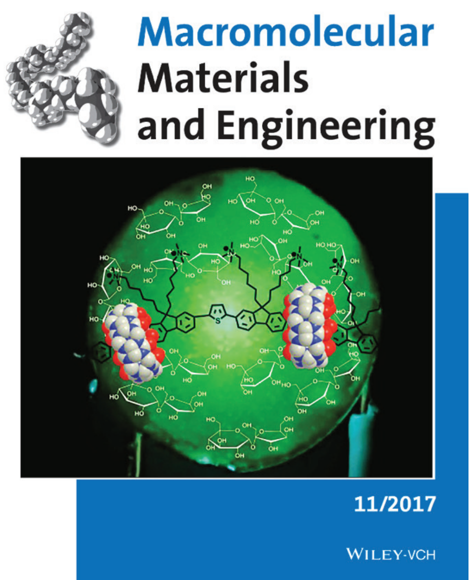
We combine intrinsically fluorescent conjugated oligomers/polymers with Au or Ag nanoparticles in one platform to be used as a multimodal therapeutic nanocarrier in which due to gold, photothermal therapy and the conjugated oligomer/polymer matrix photodynamic therapy would be possible. Moreover, nanoparticles could also be loaded with drug molecules for the additional chemotherapeutic effect. Imaging would also be possible due to the inherent luminescence properties of the matrix. Additionally, we are also working on the encapsulation of super paramagnetic iron oxide nanoparticle (SPIONs) by conjugated oligomers/polymers for dual optical and magnetic imaging applications.



Construction of multi-layered white emitting organic nanoparticles by clicking polymers, Journal of Materials Chemistry, 2015, 3, 10277-10284



One Pot Synthesis of Hybrid Conjugated Oligomer-Ag Nanoparticles, ACS Omega, 2017, 5470–5477



Photoactive conjugated polyrotaxanes/Molecular switches:

Highly Luminescent CB[7]-based Conjugated Polyrotaxanes Embedded into Crystalline Matrices, Macromolecular Materials and Engineering, 2017, 302, 1700290

Laser-material Interactions for Developing Micro/Nano Technologies

Light-matter interaction has fascinated humanity since very early times. Indeed, one of the earliest stories we have go back to the Roman times. Archimedes, a famous ancient scientist from Alexandria, is said to have destroyed the Roman fleet that aimed to invade his city, using "burning mirrors". We do not know whether this story is true, but now we have advanced technologies such as lasers, that are as exciting and can be used to further push the limits.

In the Photonics Devices Laboratory, we are interested in studying fundamental light-matter interactions and applying the resulting understanding towards, (i) 3-dimensional silicon-based technologies, (ii) fundamental optical and holographic approaches, and (iii) developing novel micro/nano-fabrication technologies and optical devices.

Silicon and the third dimension

Silicon is an excellent material for microelectronics, microfluidics, microelectromechanical (MEMS) systems and integrated photonics, with untapped potential for infrared optics. Despite the broad recognition of the importance of the third dimension, current lithography methods do not allow for the fabrication of photonic devices and functional microelements directly inside silicon chips. Available 2-D devices are broadly termed "on-chip" technologies. Due to this important limitation, the bulk of the wafers are not used, and the lack of 3-D architectures and embedded optical functionalities essentially results in the waste of the bulk of wafers.

Recently, we have developed a direct-laser-writing approach to solve this important technological problem (Tokel et al., Nature Photonics, 11, 639, 2017). With this work, for the first time, we have demonstrated 3-D fabrication capability deep inside the wafer, without damaging the wafer above or below the modifications. Further, we found that, we can introduce photonic functionalities embedded inside the wafer. Thus, we have introduced the term "in-chip" in order to broadly describe these novel devices (Tokel et al., Nature Photonics, 11, 639, 2017). We are pushing the limits of fabrication resolution these elements, and aiming to realize novel in-chip nanofabrication capabilities. An important building block of this aim will be 3-D holographic projection capability.

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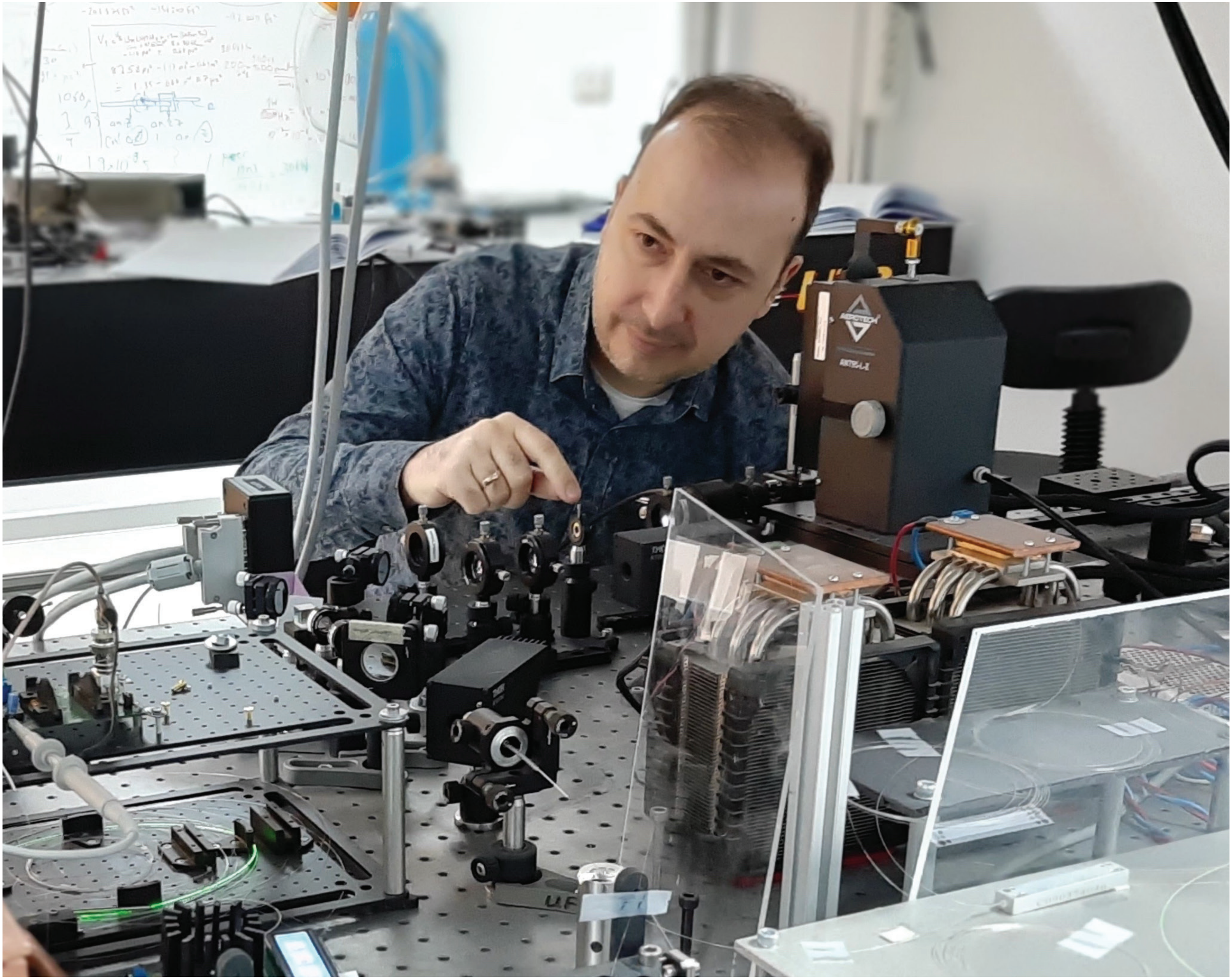
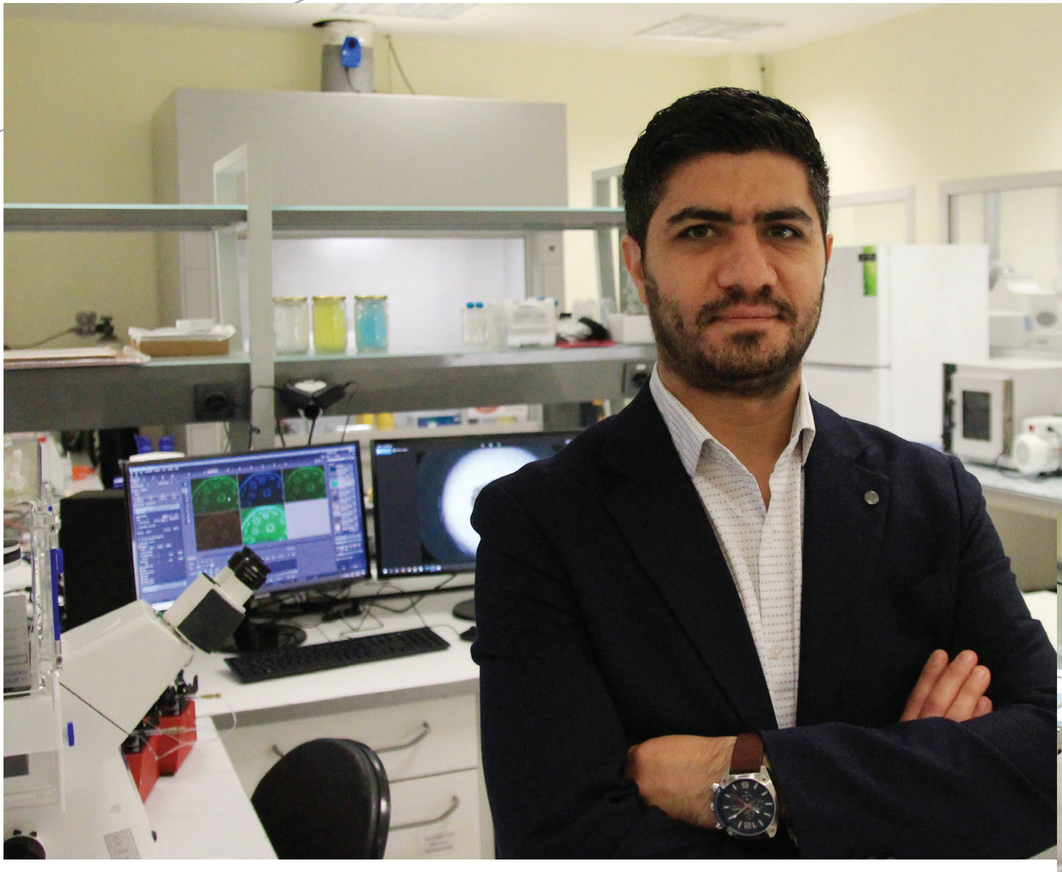
Research interests: *Fundamental light-matter interactions, from state-selective laser photolysis dynamics to fundamental photonics; and applying the resulting understanding towards novel micro/nano-fabrication technologies and optical devices*

3-D high-density holographic projection

Recently, we demonstrated a novel method for achieving truly 3D holographic projection capability (Makey et al, Nature Photonics, 13, 251, 2019). Holography is commonly seen as the most promising method for realizing true-to-life 3D images or videos. However, until recently, it has not been possible to combine complex images to realize high-density 3D holographic projections. Towards this goal, working with Dr. F. Ö. Ilday and our colleagues at Bilkent, we demonstrated such holograms. We solve this by a wavefront engineering trick, such that the projections at each depth preserve their quality, but at the same time eliminate unwanted crosstalk. We demonstrate holograms that form with full depth control without any crosstalk; producing large-volume, high-density, dynamic 3D projections with 1,000 image planes simultaneously, improving the state of the art by two orders of magnitude. We aim to use the method in developing advanced laser-writing approaches and state-of-the-art in-chip photonic technologies.

Dr. Tokel received his Ph.D. from Cornell University in Applied Physics, which is followed by his postdoctoral studies at Harvard University. He is the recipient of Young Investigator Award from the Science Academy, Turkey (BAGEP), METU Prof. Dr. Mustafa N. Parlar Foundation Research Incentive Award, TUBITAK Success Award, and Turkish Academy of Sciences Outstanding Young Investigator Award (GEBIP). His work has been published in prestigious journals including Nature Photonics, Nature Communications, ACS Nano and ACS Chemical Reviews, and commonly highlighted in national and international media, in outlets such as, MIT Tech News, Laser Focus World, Physics Today, IEEE Spectrum, Optics & Photonics News, as well as, la Repubblica, CNNTÜRK and Hürriyet newspapers.





GÜRKAN YEŞİLÖZ

Ph.D. University of Waterloo
MSN Graduate Program and UNAM

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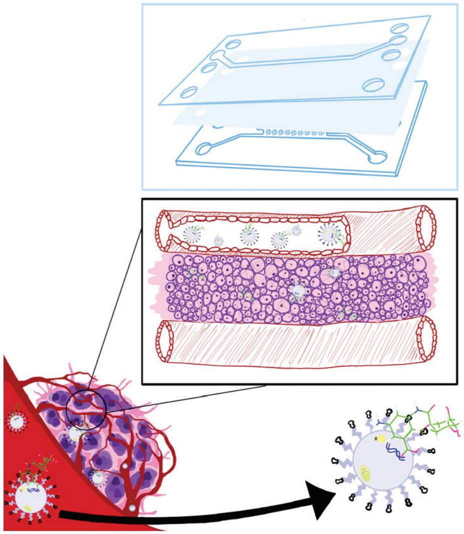
***Research interests:** BioMEMS, micro/nanofluidics devices, organ-on-chips and physiological systems, tissue engineering, drug delivery and drug screening, pathogen detection, droplet microfluidics, acoustofluidics, microwave integrated sensors/ heaters, nanoparticle synthesis and multiphase fluid interactions*

Development of Advanced Microfluidics, Microwave and Micro-tissue Integrated Systems

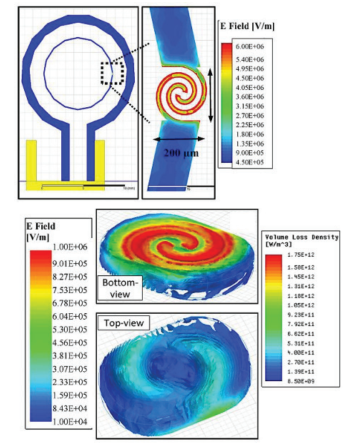
In our laboratory, we are carrying out trans-disciplinary research which intersects the engineering of biomedical devices, sensors, organ-on-chip platforms, micro and nanofluidic devices, and their applications in medicine, pharmaceutical and biochemical engineering fields. We are also giving particular focus on the development of innovative and advanced microwave/ droplet-microfluidics integrated detection and heating platforms as well as the development of in vitro micro-tissue physiological models for nanotechnology-based high-throughput drug discovery and screening.



Microphysiological systems

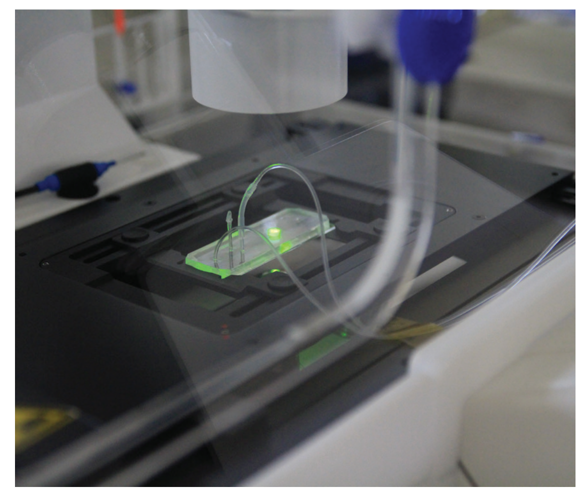
Modeling sophisticated in vitro physiological responses under accurate conditions is an emerging technological field to engineer microchips containing living cells that reconstitute organ-level-functions for drug screening, diagnostics, toxicology and therapeutic purposes.

Our group is working at the interdisciplinary edge -utilizing engineered tools to reveal secrets of complicated living systems through deep down analysis On-Chip. To grip such multifaceted analysis, sophisticated tools like sensors have been merged further, revealing every possible investigation/exploration of the 3D world, at smallest scale. Moreover, via incorporating nanomedicine practices with tailored drug delivery vehicles, our goal is to make high throughput-drug screening an everyday technique, to bring possible cures of life threatening diseases; in particular cancer.



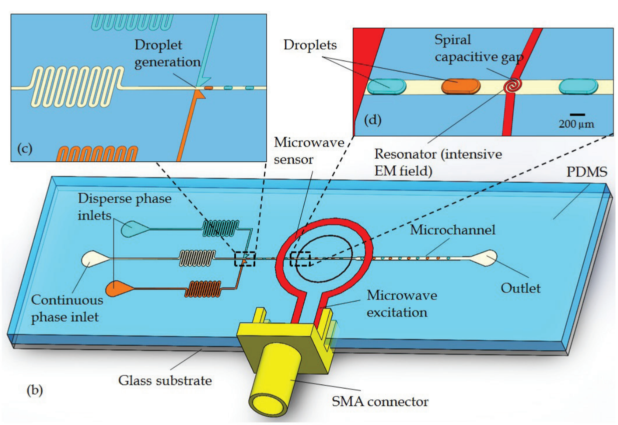
With our expertise, the real challenges we wish to overcome is to model biomimicked-3D systems at micro scale- creating actual tumor and tissue microenvironments in the fluidic chips, and integrating smart sensors to overcome sensitive detection limits while playing with the drug conjugates at minute concentrations.

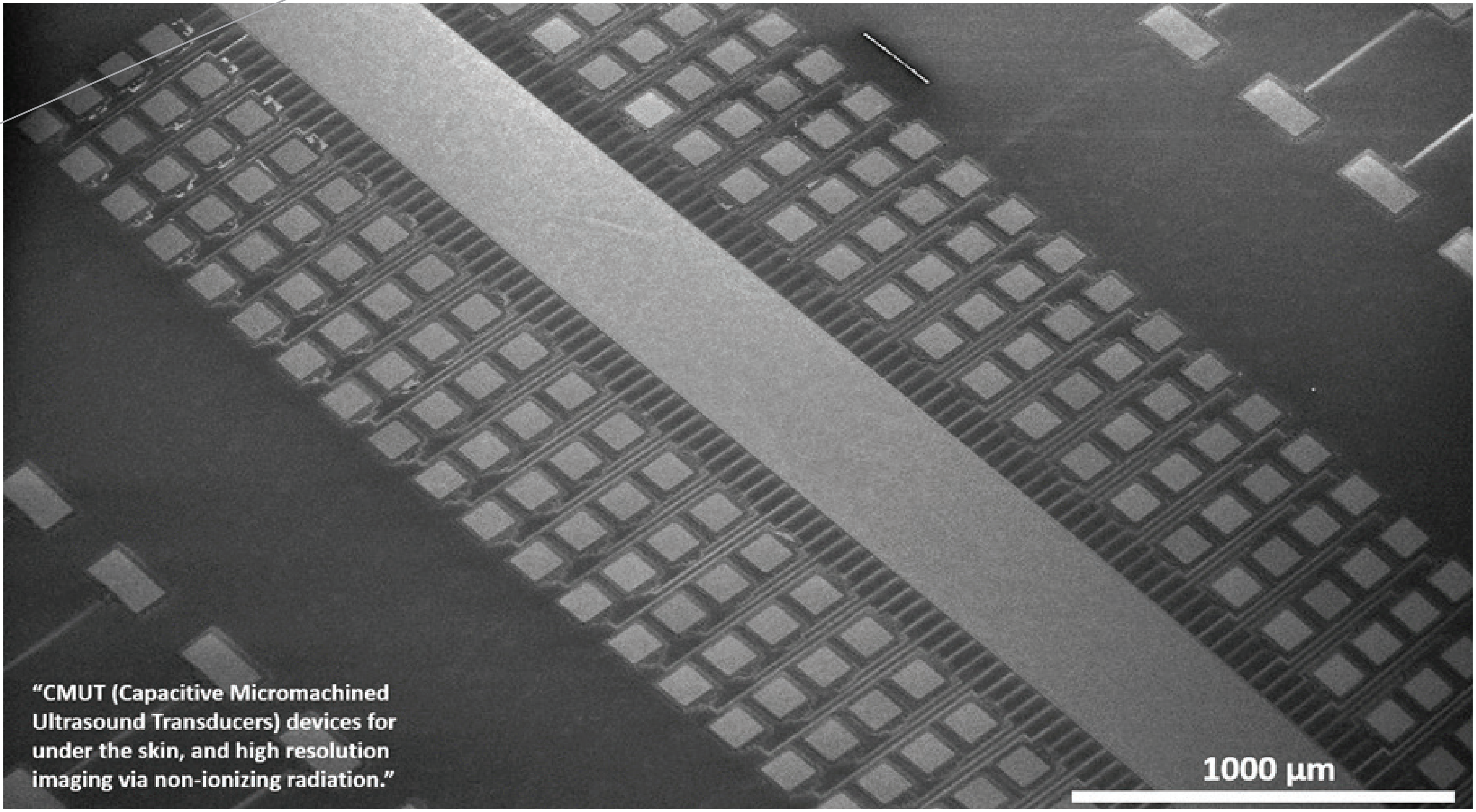
Microwave sensors/heaters and droplet-microfluidics systems



Interest in droplet-based microfluidics has grown because of their promise to facilitate a broad range of scientific research and biological/chemical processes such as cell analysis, DNA hybridization, drug screening and diagnostics. Major advantages of droplet-based microfluidics versus traditional bioassays include its capability to provide highly monodispersed, well-isolated environment for reactions with magnitude higher throughput (i.e. kHz) than traditional high throughput systems, as well as its low reagent consumption and elimination of cross contamination.

Major functions required for deploying droplet microfluidics include droplet generation, merging, sorting, splitting, trapping, sensing, heating and storing, among which sensing and heating of individual droplets remain great challenges and demand for new technology. In the light of these demands, our research line focuses on developing novel microwave technologies that is integrated with droplet-based microfluidic platforms to address these challenges.





"CMUT (Capacitive Micromachined Ultrasound Transducers) devices for under the skin, and high resolution imaging via non-ionizing radiation."

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Research interests:
Micro/nanofabrication, in-situ SEM nanomechanical characterization, MEMS, CMUT

Acoustics Research

Our group has wide range of research, design, development, and realization tools for some of the most demanding technological needs for today and tomorrow, such as medical imaging, and information transfer. We are a group of expert engineers who initiate their ideas from scratch, and realize these ideas by design, analytical modelling, finite element modelling, micro/nanofabrication, and characterization. Our research and development efforts are accumulated into the wide field of acoustics, and ultrasonics, where restless brainstorming sessions and discussions on digital integrated circuits, analog integrated circuits, transduction, electronics, and micromachined sensors such as CMUTs (Capacitive Micromachined Ultrasound Transducers) compose our research and development activities on a daily basis.

Medical imaging

This part of our research efforts use our design, modeling, batch compatible micro/nanofabrication and characterization knowledge base for the development of novel imaging technologies such as CMUT devices for under the skin, and high resolution imaging via non-ionizing radiation. In this highly interdisciplinary research field, we are working with expert engineers and scientists from different disciplines such as physics, electrical and electronics engineering, materials science and engineering, mechanical engineering, and medical doctors specialized in radiology.

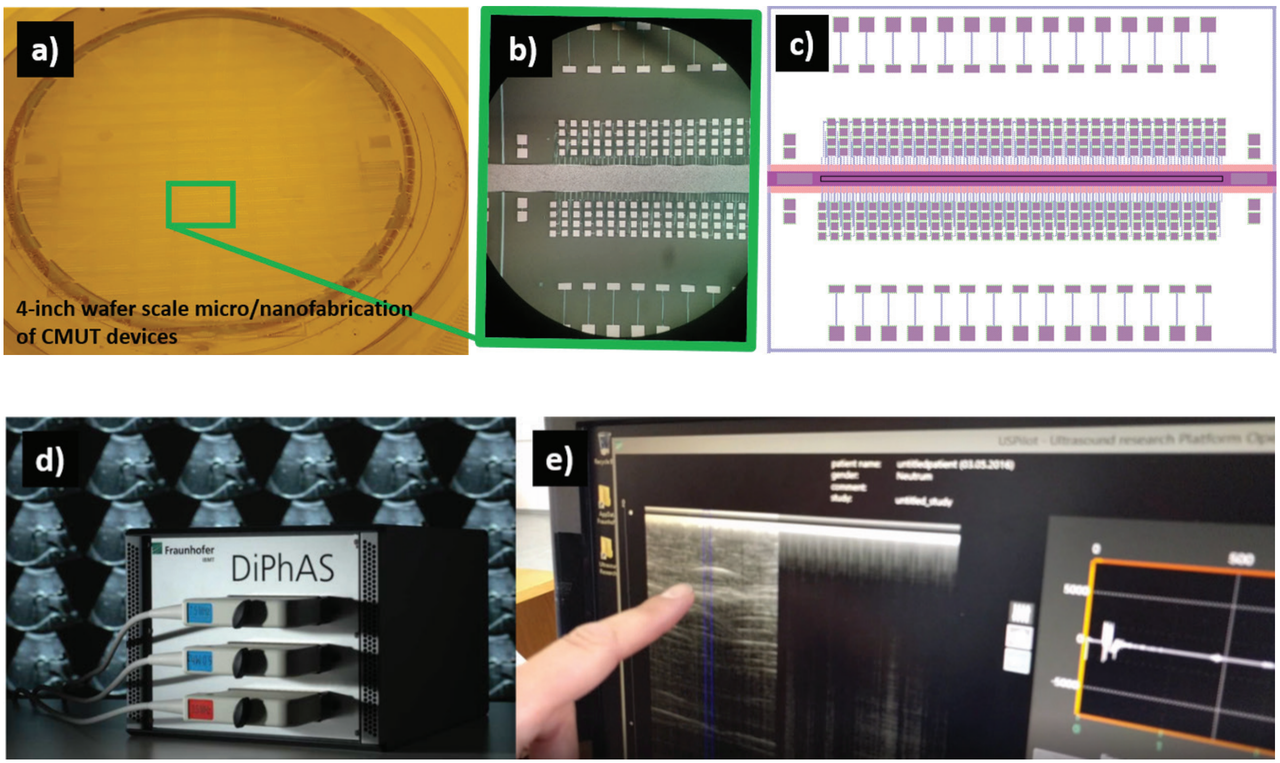

Figure: Wafer scale production of CMUT devices. a) Micro/nanofabrication of multiple CMUT chips on 4-inch full wafers, b) Part of a CMUT chip that is imaged under an optical microscope, c) Software version of the CMUT chip masks that are designed using a layout editor, d) Fraunhofer IBMT's ultrasound research platform and interface (DiPhAS), e) Ultrasound imaging with DiPhAS.

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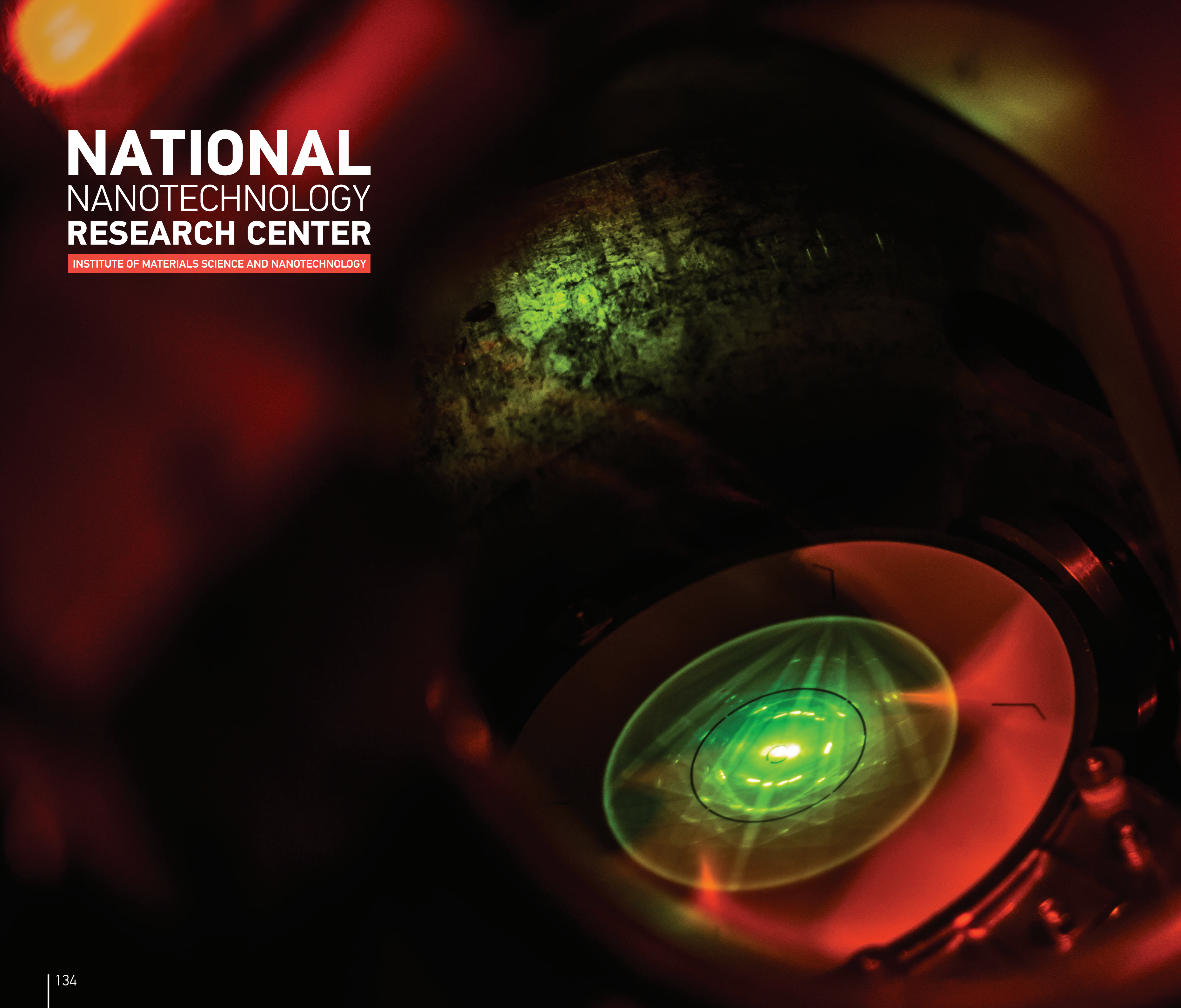

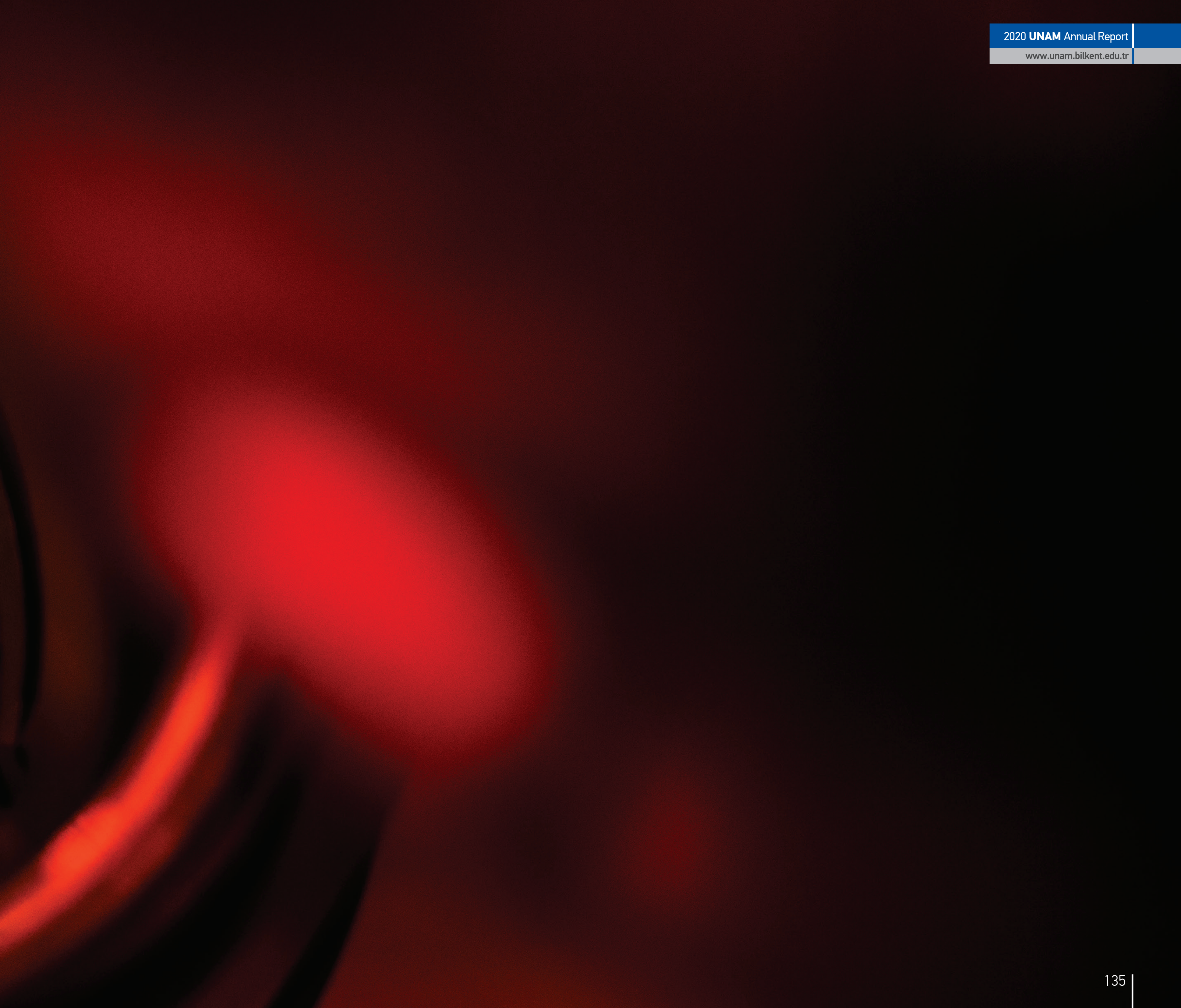

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