ANNUAL REPORT 2017

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Bilkent University UNAM National Nanotechnology Research Center

Institute of Materials Science and Nanotechnology imagine.

think.

work.

challenge.

inspire.

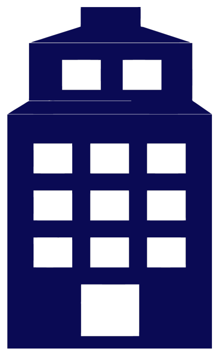
unam.

smile.

unam is supported by the Ministry of Development of Turkey under the Law on Research Infrastructure Support no 6550.

CONTENT

UNAM by NUMBERS



9200 m² total laboratory space

75 laboratories

As a national center, UNAM is continuously growing and reaching out to more scientists and researchers every year. This growth reflects itself in the scientific and technological outcomes of our center. UNAM facility has been utilized by more than 50 users per day, while there are more than 1100 users in total. As the numbers of researchers and projects are increasing, UNAM is becoming a hub for high-impact research and talent attraction.

over 1100 users

283 internal users

843 external users

(81 companies, 97 universities)

178

R&D Projects

289 researchers and staff

48 faculty members

36 scientists

22 post-docs

153 graduate students

24 engineers and technicians

6 support staff

SCI Publications

over 1000

NIP

Nature Index

Journal Publications

217

impact factor

Journals with

Impact Factor >10

103

21 spin-off companies

75 patents

26 National

49 International

392 theses completed at UNAM

284 MS

108 PhD

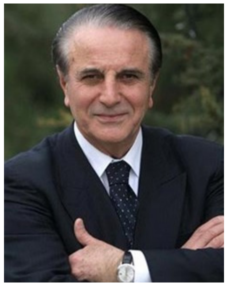
in MSN and other graduate programs

92 awards

49 National

43 International

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.
"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. As a citizen, scholar, I would like to express my deep esteem and gratitude to the Founding Director Salim Çıracı, to all those who contributed and are contributing to the achievements of this remarkable research center.

Prof. Orhan Güvenen
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, UNAM is definitely one of the best. UNAM's world-class research infrastructure and facilities within a single building makes it an extremely productive environment to 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 empower its researchers to become world leading experts. Overall, I feel very grateful for all resources that UNAM provides, which make it possible to have fruitful research experience.

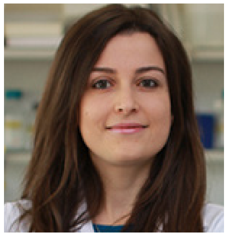
Dr. Burak Güzeltürk, EE and UNAM'16
Currently Postdoctoral Researcher at Stanford University
CA, USA

During my PhD, under supervision of Prof. Hilmi Volkan Demir, I had the opportunity to access the unique intellectual 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 scientist by acquiring a significant degree of new knowledge and technical/scientific skills and broadening our horizon. Therefore, I feel very lucky to be a graduate of UNAM and I am grateful for all resources that UNAM provides during our studies.

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

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 and integrate international scientific society. I hope UNAM will keep growing and succeed new achievements.

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



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 to UNAM who offered me this opportunity.

Dr. Melike Sever, MSN and UNAM'17
Currently Postdoctorol Researcher at Hacettepe University

During my PhD I had the opportunity to access to 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 information, talent, and self-confidence that is needed. Therefore, I fell very lucky to be a scientist who has been trained at UNAM.

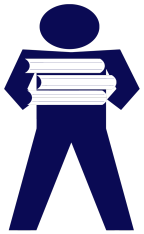
Dr. Talha Erdem, EE and UNAM'16
Currently Postdoctoral Researcher at University of Cambridge
UK

UNAM trains scientists that are renowned worldwide and hosts researchers conducting cutting-edge scientific research and projects with its, high-tech infrastructure, high quality cleanroom, top-notch academic staff and with the innumerable research opportunities it provides. While the interdisciplinary masters, PhD and postdoctoral research programs UNAM offers help researchers to improve themselves in various fields; it also leads global scientific outputs formed by merging different principals. During my PhD at UNAM, I published scientific papers in top-class international journals and had the chance to attend significant international conferences as a speaker. In addition to those, thanks to the potentials offered to me by UNAM, I had the opportunity to meet scientists working on different research fields all around the world. I can frankly say that UNAM, with its current potential and capacity, is one of its best in its field, not only in Turkey but also in Europe.

Dr. Pelin Toren, MSN and UNAM'17
Currently Scientist at Joanneum Research
Austria

MSN Graduate Program

Education activities at UNAM are organized through our Material Science and Nanotechnology (MSN) program. We are currently offering Master of Science (M.Sc.) and Philosophy of Doctorate (Ph.D.) degrees under MSN program. As of 2017, MSN program has 26 M.Sc. students and 29 Ph.D. students. We accept students from a wide variety of backgrounds. There are students from nearly all engineering fields (31%) and fundamental sciences (69%). Currently, we have students/post-docs from different countries. UNAM is the choice of researchers who are seeking a multidisciplinary and multinational environment.



In MSN
174 theses
114 MS
60 PhD

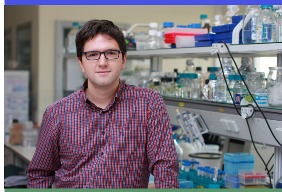
Current research in nanoscience and nanotechnology requires an advanced knowledge in materials science and involves design and fabrication of novel and functional nanostructures. The graduate program in Materials Science and Nanotechnology is an interdisciplinary study and aims to train researchers who can pursue outstanding and creative research in the diverse fields of nanoscience and nanotechnology, such as nanobiotechnology and nanomedicine; atomic scale imaging; nano and microelectronics; nanotextile; nanophotonics; femtosecond lasers; spintronics; advanced materials design and manufacturing of nanofibers; nanotribology, hydrogen economy and solar energy. The graduate program provides an in- depth understanding of materials at nanometer scale and present an excellent training starting from the quantum theory of matter and complexity in biology. The graduate courses to be taken by the students focus on his/her thesis work.

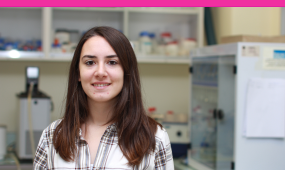
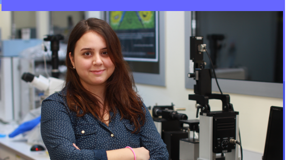
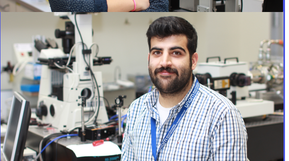
Course Code	Course Name
MSN 500	Concepts in Materials Science
MSN 501	Atomic Structure, Mechanical and Thermal Properties of Materials
MSN 510	Imaging Techniques in Materials Science and Nanotechnology
MSN 512	Biomedical Materials
MSN 513	Micro and Nanostructured Sensors
MSN 514	Computational Methods for Material Science & 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 526	Functional Surfaces and Interfaces
MSN 533	Nanomaterieals for Energy Conversation and Storage
MSN 534	Polymeric Materials
MSN 541	Nanobiotechnology
MSN 551	Introduction to Micro and Nanofabrication
MSN 555	Nanomaterials Processing by Intense Laser Beam
MSN 598	Seminar I
MSN 599	Master's Thesis
MSN 698	Seminar II
MSN 699	Ph.D. Thesis

UNAM ALUMNI

UNAM graduates continue their careers at the world's leading universities or start industrial careers at high-tech companies. Below is a list of UNAM alumni and their current positions. Thanks to the world-class education provided at UNAM, our alumni are well sought after both in academia and industry.

Name	Current Position
Adem Yildirim	University of Colorado - Postdoctoral Researcher
Aslı Çelebioğlu	University of Cambridge - Postdoctoral Researcher
Bilal Kılıç	Türk Hava Yolları - Pilot
Berna Şentürk	EMPA - Postdoctoral Researcher
Bülent Öktem	Aselsan- Project Engineer
Büşra Mammadov	Product Manager - Sentegen Biotechnology
Burcu Gümüşçü	UC Berkeley, Herr Lab - Postdoctoral Researcher
Cagla Akgun	Project Engineer, Aselsan
Canan Kursungoz	Interlab - Specialist
Erol Özgür	University of Arizona - Postdoctoral Researcher
Fatma Kayacı	TÜBİTAK-SAGE - Specialist
Göksu Çınar	KTH Royal Institute of Technology - Postdoctoral Researcher
Gökçe Küçükayan Doğu	Intel Corp. (Phoenix, AZ)- Process Engineer
Gözde Uzunallı	Purdue University- Postdoctoral Researcher
Hakan Ceylan	Max Planck Institute- Postdoctoral Researcher
Handan Acar	University of Oklahoma - Asst. Prof.
Hasan Güner	Ertunç Özcan Sağlık Tesisleri ve Tıbbı Cihazlar - Uzman Mühendis
Hasan Şahin	IYTE - Assoc. Prof.
Hilal Ünal Gülsüner	Washington University- Postdoctoral Researcher
Hülya Budunoğlu	Aselsan- Project Engineer
Ilke Simsek Turan	R&D - Patent Uzmanı
Kıvanç Özgören	FibLas Fiber Lazer San. Tic. Ltd. - General Manager
Mehmet Kanık	MIT - Postdoctoral Researcher



Mehmet Topsakal	University of Minnesota - Research Associate, Brookhaven National Laboratory
Mohammad Aref Khalil	University of Twente - Postdoctoral Researcher
Mutlu Erdoğan	Max Planck Institute- Postdoctoral Researcher
Okan Öner Ekiz	Nanodev Mühendislik - Founder and CEO
Omer Faruk Sarıoğlu	E-Kalite Software - Researcher / Data Analyst
Onur Büyükçakır	University of Kaist- Postdoctoral Researcher
Pelin Tören	Joanneum Research - Scientist
Rashad Mammadov	Virginia University- Postdoctoral Researcher
Ruslan Garifullin	Kazan (Volga Recion) Federal University - Postdoctoral Researcher
Ruslan Guliyev	Rutgers University- Postdoctoral Researcher
Safacan Kölemen	Koç University - Asst. Prof.
Seher Yaylacı	Bilkent University - Postdoctoral Researcher
Sencer Ayas	Stanford University- Postdoctoral Researcher
Seydi Yavaş	Boğaziçi University & Founder of Lumos Laser
Seymur Cahangirov	Bilkent University - Asst. Prof.
Sündüs Erbaş Çakmak	Konya Food and Agriculture University - Asst. Prof.
Taha Bilal Uyar	Coante Quartz Surfaces - Research and Development Manager
Tolga Tarkan Ölmez	University of Yale - Postdoctoral Researcher
Tuğba Özdemir Kütük	Bilkent University - Postdoctoral Researcher
Tural Khudiyev	MIT - Postdoctoral Researcher
Veli Ongun Özçelik	Princeton University- Postdoctoral Researcher
Yusuf Çakmak	Konya Food and Agriculture University - Postdoctoral Researcher
Zeynep Aytaç	University of Michigen - Postdoctoral Researcher
Ebru Cihan	Karlsruhe Institute of Technology (KIT), PhD Student
Elif Ertem	Federal Polytechnic Institute, Zurich, PhD Student
Yusuf Keleştemur	ETH Zurich - Postdoctoral Researcher
Samet Kocabey	Ludwig Maximilian University of Munich, PhD student
Turan Selman Erkal	University College London - Postdoctoral Researcher

UNAM INFRASTRUCTURE

UNAM building has been designed to be a multidisciplinary research environment for researchers from various disciplines. Since the establishment of UNAM, the infrastructure has been developed to satisfy the needs of researchers from universities and institutions in Turkey and neighboring countries. With its ever expanding capabilities, UNAM is providing the 21st century state-of-the-art technology to support the research and development activities. As equally importantly, the specialized instruments can be utilized with the guidance of highly qualified technical personnel. The novice users are accompanied by experienced UNAM personnel in order to make the most of the time they spend at UNAM facility.

UNAM infrastructure is maintained regularly to satisfy the need of researchers. The details of each instrument can be viewed on our facility webpage. UNAM information system, UNAM-IS, is a one-stop address to have access to all equipment. The users first sign up to receive their username and password. After defining their project, they can access the listed equipment. The reservation procedure is hassle-free. The authorized users can monitor the availability of the equipment and make a reservation from the UNAM-IS portal.

Imaging / Microscopy

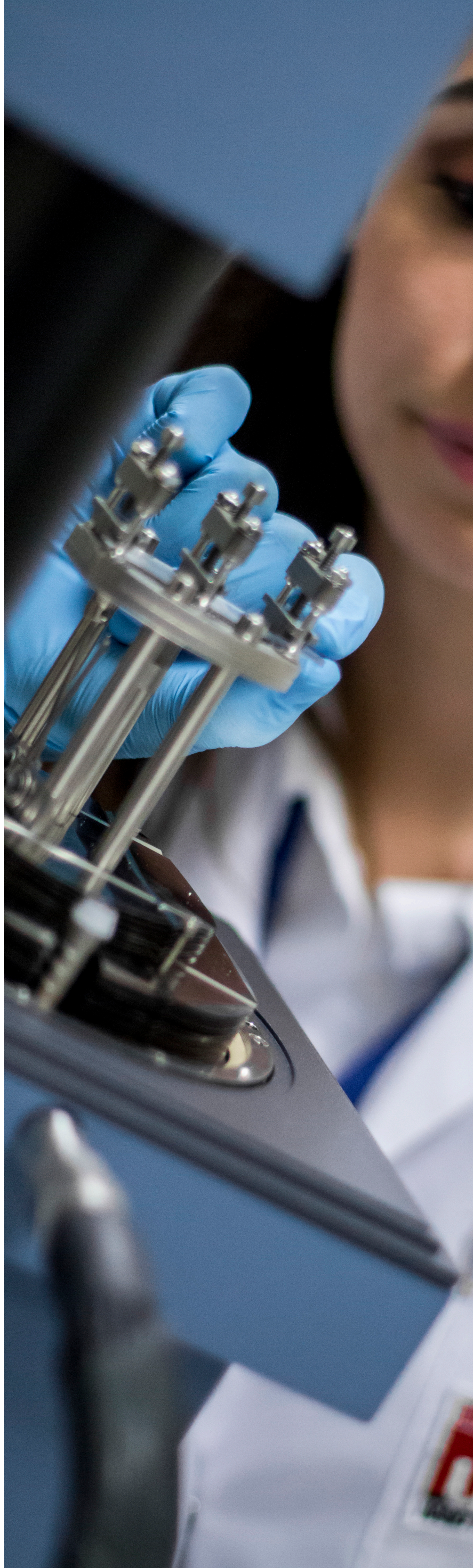
Atomic Force Microscope (AFM, PSIA)
Atomic Force Microscope (AFM, Asylum)
Confocal Microscope
Dual Beam
E-Beam Lithography (E-BEAM)
Environmental Scanning Electron Microscope (ESEM)
Fluorescent and DIC Equipped Upright Microscope
Fluorescent and DIC Equipped Inverted Microscope
Material Microscopes
SNOM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

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



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
Glovebox
Isotermal Titration Calorimetry (ITC)
Materials Research Diffractometer (MRD)
Micromechanical Tester
Multi-Purpose X-Ray Diffractometer
Porosimeter
Physical Property Measurement System (PPMS)
Pycnometer
Rheometer
Single-Crystal X-Ray Diffractometer
Thermal Gravimetric Analysis (TGA)
Zeta Potential (Zeta Sizer)

Cleanroom

Asher
Atomic Layer Deposition (ALD, Fiji)
Atomic Layer Deposition (ALD, Savannah)
Autoclave
Critical Point Dryer
Dicing Saw
Die Bonder
E-Beam Evaporation
Electroplating Station
Hot Plates
Inductively Coupled Plasma (GaN, GaAs)
Inductively Coupled Plasma (Si)
Low Pressure Chemical Vapor Deposition (LPCVD)
Mask Aligner
Mask Aligner with Nanoimprint Lithography
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
Stylus Profilometer
Thermal Evaporators
Wet Benches
Wire Bonders
XeF_2 Etcher

Biotechnology

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

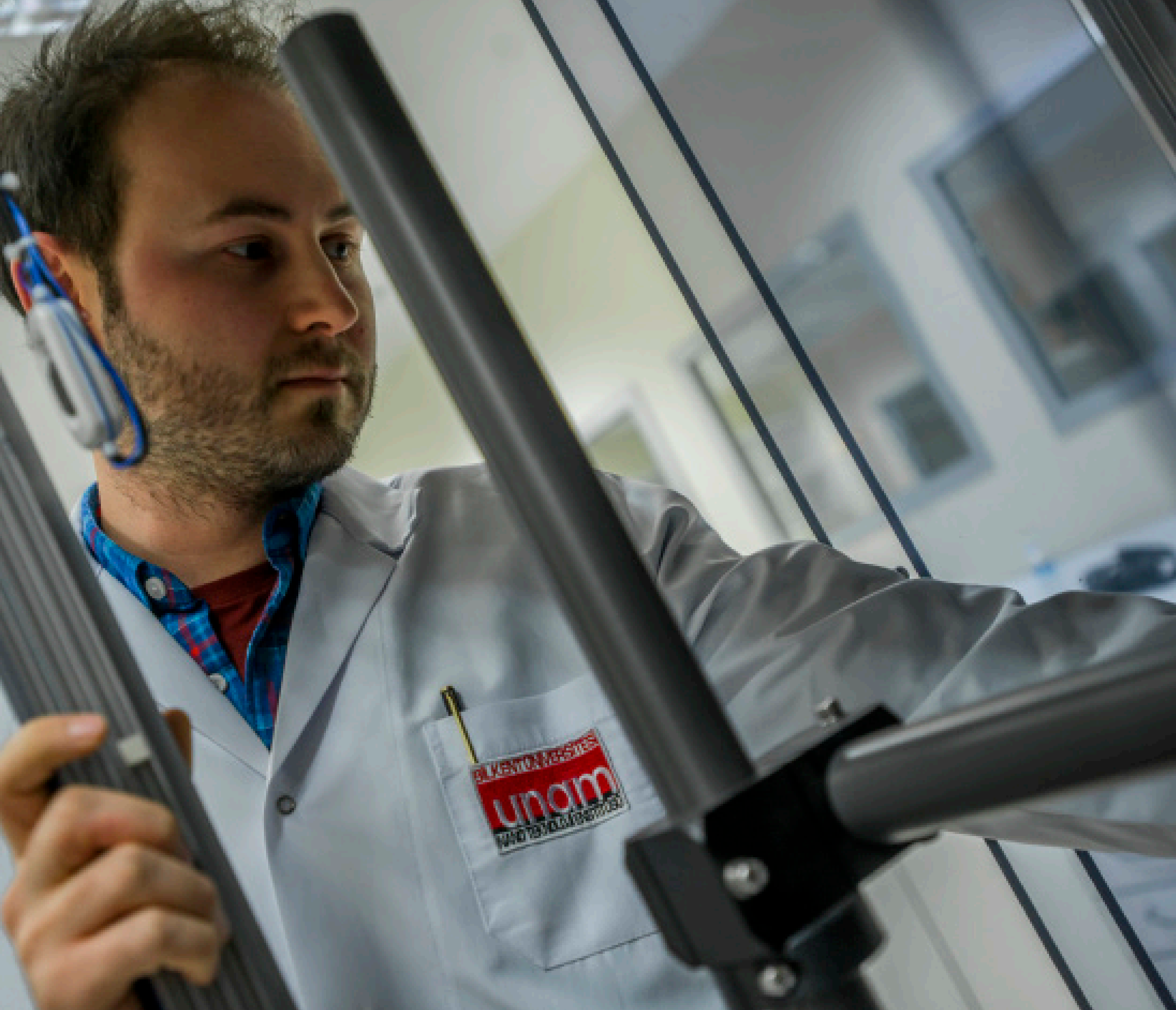
Fiber Production / Characterization

Fiber Draw Tower
Fiber Draw Tower (High temperature up to 2300 ºC)
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 (1200 ºC)
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

CONTRIBUTIONS TO INDUSTRY AND ACADEMIA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PARTNERSHIPS

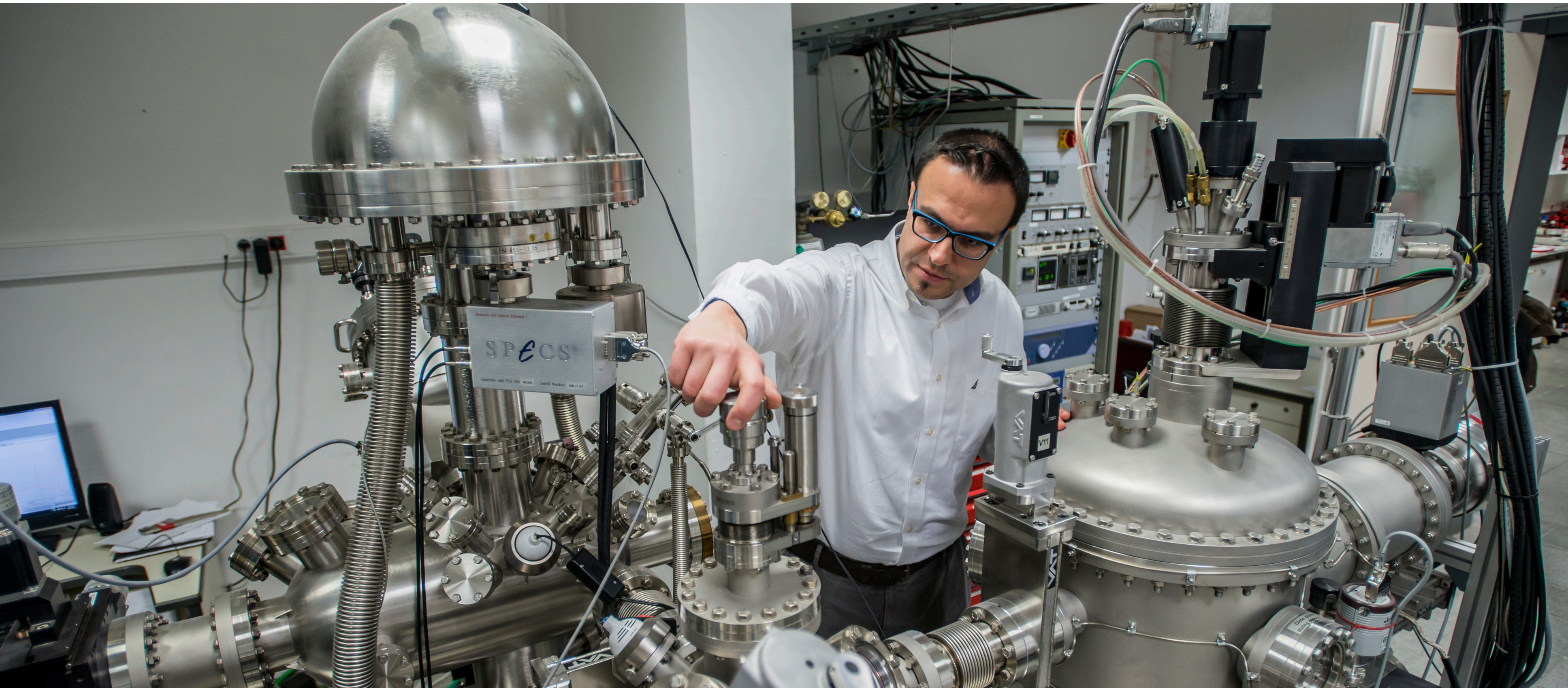
HACETTEPE - BİLKENT UNAM STRATEGIC PARTNERSHIP in HEALTH SCIENCES and TECHNOLOGIES

The Hacettepe-Bilkent Health Sciences and Technologies (HST) Program has been established through the Memorandum of Understanding signed by Hacettepe University Rector Professor Özen and Bilkent University Rector Professor Atalar. This MoU will allow for the shared use of infrastructural resources and will create a new joint platform for collaborative studies at UNAM bringing together researchers in basic sciences, engineering and medicine.

Partnership with Industry

UNAM fosters an environment promoting industry and academia partnership. Researchers at UNAM run interdisciplinary projects and meet the expectations of industrial partners. UNAM aims at developing the scientific and technological capacity of SMEs and large organizations through joint projects and short-term industrial contracts. Additionally, UNAM infrastructure enables the companies to have access to the state-of-the-art equipment and the know-how for their specific needs.

UNAM's 400 m² cleanroom and 250 m² UNAM ARL Cleanroom comprise class 10, 100 and 1000 areas and are being further developed according to the needs of our researchers. Currently, there are over 25 companies using the UNAM infrastructure on a regular basis. The total number of users from universities has exceeded 1000 in 2017. Since UNAM is being used by many researchers of different interests, it provides researchers with an excellent opportunity for networking as well. As the need for value-added products in Turkey is increasing, UNAM will serve to more people with its technological capacity and know-how. The feedback we receive from users is very encouraging and pushes us further in meeting the needs of all of our partners. In 2017, UNAM has also improved the training procedures for the first-time users. The users are being served by a centralized contact point and can receive comprehensive hands-on tutorial and guidance from our dedicated personnel.



Companies utilizing UNAM infrastructure include:

AB-MikroNano	ETİ MADEN	NUROL MAKİNE
AGAMİRZE	FOTONİKA	OKYAY ENERJİ
AKZO NOBEL BOYA	GATA	ÖZTEK TEKSTİL
ARGETEST	GENAMAR AR-GE	PAŞABAHÇE
ARITEKS	GO ENERJİ	PLASBANT PALSTİK
ART BANT	HAYAT KİMUA	PMS MEDİKAL
AS İNŞAAT	HEMOSOFT BİLİŞİM	ROKETSAN
ASELSAN	İ5 DOĞA İLETİŞİM	ROKETSAN
ATAKİM BOYA	İBA VALSERA	ROKETSAN
BAYRAK AR-GE	İKSA LTD.	SASAN MEDİKAL
BEREN ECZA DEPOSU	İNOVAKTİF	SENSES
BETOPAN	İSKO-SANKO	SERMED TIBBİ CİHAZLAR
BİYOTEZ	KORDSA	ŞİŞECAM
BOSCH SIEMENS	KOROZO	SİSTEM ALUMİNYUM SANAYİ
BOYLAM YAZILIM	MAN	SO SOĞUTMA
Creon İleri Teknoloji ve Mühendislik A.Ş.	METEKSAN	SPM A.Ş
CYBERPARK	MİKRO BİYOSİSTEMLER	STC ELEKTRONİK
DELTAMED	MİKRON MAKİNA	TDU SAVUNMA SUN TESKTİL
DİZAYN GRUP	MİKROSİSTEMLER	TEKSER
DROGSAN ECZACILIK	MİT	TÜBITAK UZAY
DST MEDİKAL	MONO KRİSTAL TEKNOLOJİLERİ	TÜPRAŞ
DYO	MTA	TÜRKİYE PETROLLERİ
E-A TEKNOLOJİ	NANODEV	TUSAS
E-BERK MAKİNA	NANOGRAFİ	VAKSİS
ECZACIBAŞI	NEHİR BİYOTEKNOLOJİ	VAMED MEDİKAL
EMBİL İLAÇ	NORMMED MEDİKAL	VAMET MAKİNE
ERMEKSAN	NUROL	VİROSENS MEDİKAL

UNAM SPIN-OFFs

As being the first and only national nanotechnology research center 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. UNAM spin-off companies include:

- Auron Teknoloji
- Biyonesil
- Deber
- E-A Teknoloji
- Innovcoat
- Innovnano
- IPS Ankara Tekno Bilişim Ar-Ge
- LST Scientific
- Nanobiyoteknoloji
- Nanodev
- Nanosens
- Niser
- SY Nanoboya Teknoloji
- Synbiotik

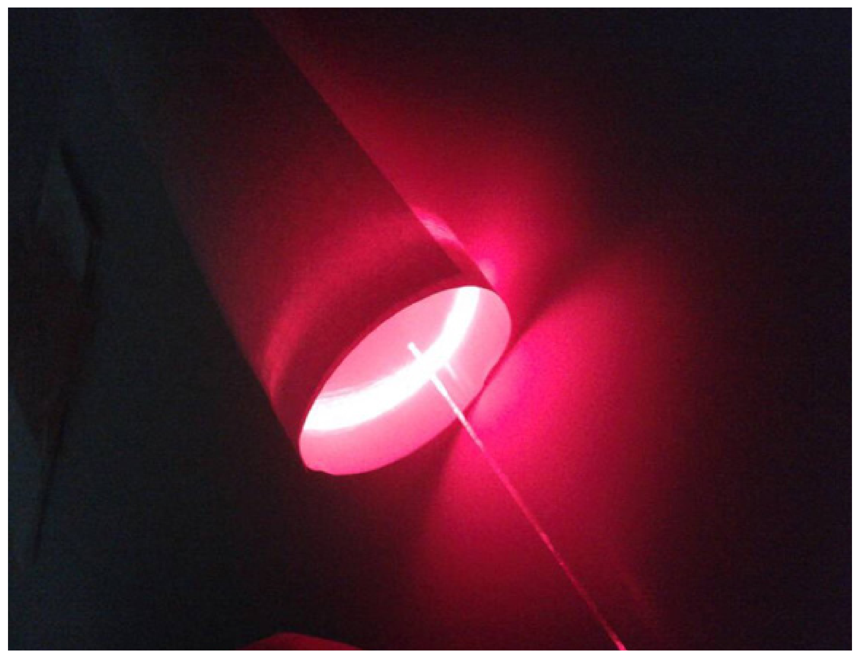
Nanodev Scientific

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 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 markers for a heart attack or an infectious disease. Such early detection tools are some of the innovative products that Nanodev is developing.

Nanodev booth at Materials Research Society Spring Meeting
San Fransico, CA, USA

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 were very motivating, indicating that 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.



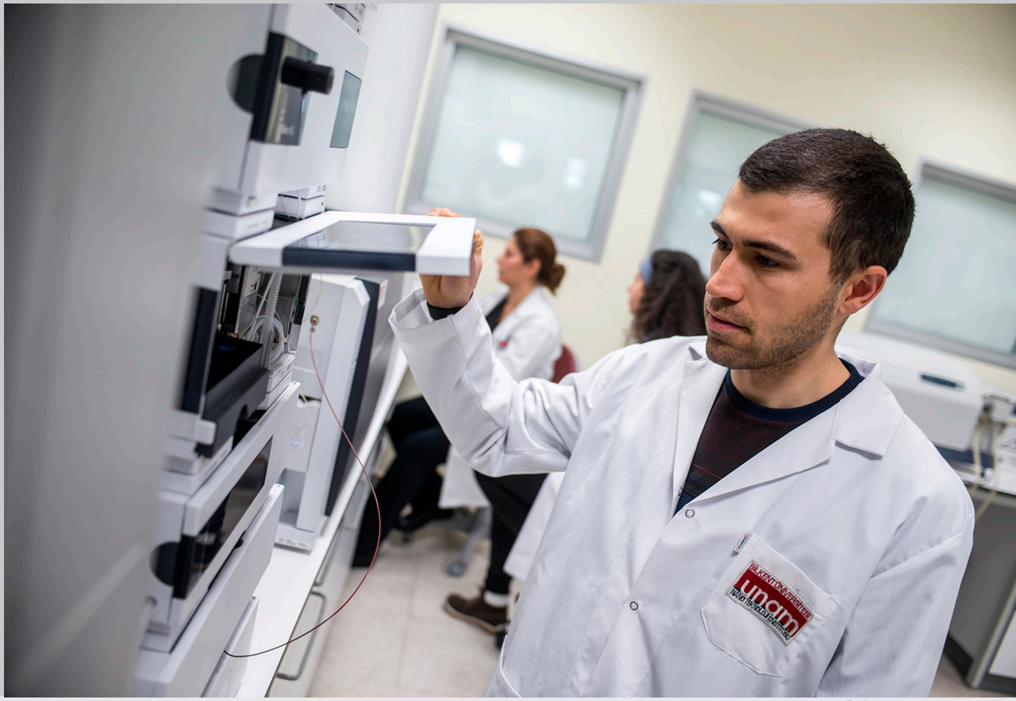
UNAM USERS ALL ACROSS TURKEY

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 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 1000 users of UNAM. Being located in Ankara, UNAM is accessible to all researchers across Turkey. In 2017, the number of universities who are utilizing UNAM has reached 97. 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 provided. 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.



Universities utilizing UNAM infrastructure include:

19 MAYIS ÜNİVERSİTESİ(SAMSUN)	DUMLUPINAR ÜNİVERSİTESİ(KÜTAHYA)	KOÇ ÜNİVERSİTESİ(İSTANBUL)
ABANT İZZET BAYSAL ÜNİVERSİTESİ	DÜZCE ÜNİVERSİTESİ	KÜTAHYA ÜNİVERSİTESİ(KÜTAHYA)
ABDULLAH GÜL ÜNİVERSİTESİ(KAYSERİ)	EGE ÜNİVERSİTESİ(İZMİR)	MALTEPE ÜNİVERSİTESİ
ACIBADEM ÜNİVERSİTESİ	ERCİYES ÜNİVERSİTESİ(KAYSERİ)	MEHMET AKİF ERSOY ÜNİVERSİTESİ
ADNAN MENDERES ÜNİVERSİTESİ	ERZİNCAN ÜNİVERSİTESİ	MELİHŞAH ÜNİVERSİTESİ(KAYSERİ)
AFYON KOCATEPE ÜNİVERSİTESİ	ERZURUM TEKNİK ÜNİVERSİTESİ	MERSİN ÜNİVERSİTESİ(MERSİN)
AHİ EVRAN ÜNİVERSİTESİ	FIRAT ÜNİVERSİTESİ	MUSTAFA KEMAL ÜNİVERSİTESİ(HATAY)
AKDENİZ ÜNİVERSİTESİ (ANTALYA)	GAZİ OSMAN PAŞA ÜNİVERSİTESİ	NAMIK KEMAL ÜNİVERSİTESİ
AKSARAY ÜNİVERSİTESİ	GAZİ ÜNİVERSİTESİ(ANKARA)	NECMETTİN ERBAKAN ÜNİVERSİTESİ
AMASYA ÜNİVERSİTESİ	GEBZE TEKNİK ÜNİVERSİTESİ	NEVŞEHİR ÜNİVERSİTESİ(NEVŞEHİR)
ANADOLU ÜNİVERSİTESİ(ESKİŞEHİR)	GEBZE YÜKSEK TEK. ENSTİTÜSÜ	NİĞDE ÜNİVERSİTESİ
ANKARA ÜNİVERSİTESİ(ANKARA)	GİRESUN ÜNİVERSİTESİ	NİŞANTAŞI ÜNİVERSİTESİ
ARDAHAN ÜNİVERSİTESİ	HACETTEPE ÜNİVERSİTESİ (ANKARA)	ORDU ÜNİVERSİTESİ (ORDU)
ATATÜRK ÜNİVERSİTESİ(ERZURUM)	HARRAN ÜNİVERSİTESWİ	ORTA DOĞU TEKNİK ÜNİVERSİTESİ (ANKARA)
ATILIM ÜNİVERSİTESİ(ANKARA)	HİTİT ÜNİVERSİTESİ(ÇORUM)	OSMANGAZİ ÜNİVERSİTESİ(ESKİŞEHİR)
BALIKESİR ÜNİVERSİTESİ(BALIKESİR)	İNÖNÜ ÜNİVERSİTESİ(MALATYA)	OSMANİYE KORKUT ATA ÜNİVERSİTESİ
BAŞKENT ÜNİVERSİTESİ(ANKARA)	İSTANBUL MEDENİYET ÜNİVERSİTESİ	PAMUKKALE ÜNİVERSİTESİ
BEYKENT ÜNİVERSİTESİ	İSTANBUL TEKNİK ÜNİVERSİTESİ(İSTANBUL)	RECEP TAYYİP ERDOĞAN ÜNİVERSİTESİ
BİLECİK ŞEYH EDEBALİ ÜNİVERSİTESİ	İSTANBUL ÜNİVERSİTESİ(İSTANBUL)	SABANCI ÜNİVERSİTESİ(İSTANBUL)
BİNGÖL ÜNİVERSİTESİ(BİNGÖL)	İZMİR KATİP ÇELEBİ ÜNİVERSİTESİ	SAKARYA ÜNİVERSİTESİ(SAKARYA-ADAPAZARI)
BOĞAZİÇİ ÜNİVERSİTESİ(İSTANBUL)	İZMİR ÜNİVERSİTESİ	SELÇUK ÜNİVERSİTESİ
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BÜLENT ECEVİT ÜNİVERSİTESİ	KADİR HAS ÜNİVERSİTESİ	TRAKYA ÜNİVERSİTESİ
CELAL BAYAR ÜNİVERSİTESİ	KAFKAS ÜNİVERSİTESİ	ULUDAĞ ÜNİVERSİTESİ (BURSA)
CUMHURİYET ÜNİVERSİTESİ (SİVAS)	KAHRAMAN MARAŞ SÜTÇÜ İMAM ÜNİVERSİTESİ	ULUSLARARASI ANTALYA ÜNİVERSİTESİ(ANTALYA)
ÇANKAYA ÜNİİVERSİTESİ(ANKARA)	KARABÜK ÜNİVERSİTESİ(KARABÜK)	YAKIN DOĞU ÜNİVERSİTESİ (KKTC)
ÇANKIRI KARATEKİN ÜNİVERSİTESİ	KARADENİZ TEKNİK ÜNİVERSİTESİ (TRABZON)	YEDİTEPE ÜNİVERSİTESİ
ÇUKUROVA ÜNİVERSİTESİ(ADANA)	KARAMANOĞLU MEHMET BEY ÜNİVERSİTESİ	YILDIRIM BEYAZIT ÜNİVERSİTESİ (ANKARA)
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DOĞU AKDENİZ ÜNİVERSİTESİ	KIRIKKALE ÜNİVERSİTESİ(KIRIKKALE)	ZİRVE ÜNİVERSİTESİ
DOKUZ EYLÜL ÜNİVERSİTESİ(İZMİR)	KOCAELİ ÜNİVERSİTESİ(KOCAELİ)	

TOTAL: 95 Universities

FEEDBACK FROM THE UNAM USERS

I have performed my experimental analyses (ESEM, Rheology, DSC, TGA, Zeta potential) at UNAM during my project. I presented my data obtained from UNAM in international journals and at congresses. I am satisfied with the services provided by professional, helpful and personnel of UNAM.

Asst. Prof. Dr. Serap Durkut
Ankara University

I had a chance to take support from UNAM services during my project. During the project, section imaging and specimen preparation were performed with focused ion beam (FIB). The knowledge and support of the FIB engineers helped us a lot to perform the experiment. I am happy to use UNAM services. I thank all UNAM family who provide the wonderful service.

Assoc. Prof. Dr. Serife Yalcin
Harran University

We carried out spectroscopic ellipsometry and X-ray Photoelectron Spectroscopy analyses for our studies at UNAM. First of all, UNAM has a well-established reservation system which I found very useful and user-friendly. More importantly, experts give valuable feedback before, during and after the analyses and they are indeed worth his/her salts. I would like to take this occasion to thank UNAM and their staff for the precious work and contributions.

H.Ceren Ateş
Mikro Biyosistemler Electronics


PI 10x/23
unam
ULUSAL NANOTEKNOLOJİ ARAŞTIRMA MERKEZİ
MALZEME BİLİMİ VE NANOTEKNOLOJİ ENSTİTÜSÜ

Researchers “open up” silicon to 3D fabrication

A team of researchers centered at Bilkent University and UNAM as well as Middle East Technical University has for the first time demonstrated arbitrary 3D fabrication inside silicon, opening the way to 3D electronic and photonic devices. The team described their work in the latest issue of Nature Photonics, a top-ranked journal in its field. This new method uses a laser beam to create 1 µm-sized building blocks (one-hundredth of the diameter of the human hair) in a sliver of silicon, which are then used to fabricate new types of silicon devices.

Silicon is the bedrock of modern computers, mobile communications and photonic devices. These technologies are continually enabling more functionality and speed. Precisely because of such amazing successes, it may be surprising to learn that virtually none of these advances are taking advantage of the vast space available below the surface, inside the silicon wafers. Thus, when the team decided to make use of the unused volume inside silicon, there was no method that could enable their goal. However, they soon found that a focused laser can help to overcome the “dimensional barrier,” enabling the assemblage of 3D elements for advanced functionality inside silicon.

“We achieve this by exploiting dynamics arising from nonlinear laser interactions, leading to controllable building blocks,” says Prof. Onur Tokel of the Department of Physics and UNAM at Bilkent, who is the lead author of the paper. “In any 3D fabrication method, there is a trade-off between speed, resolution and complexity. With our approach, we’re hitting the sweet spot. The key is recognizing that most practical components can be made out of rod- or needle-like building blocks. Our method enables the creation of such blocks, while also preserving a width of about one micrometer. Better yet, these blocks can be combined to create a 2D layer, or even more complex 3D shapes, simply by scanning the laser beam over the chip.”

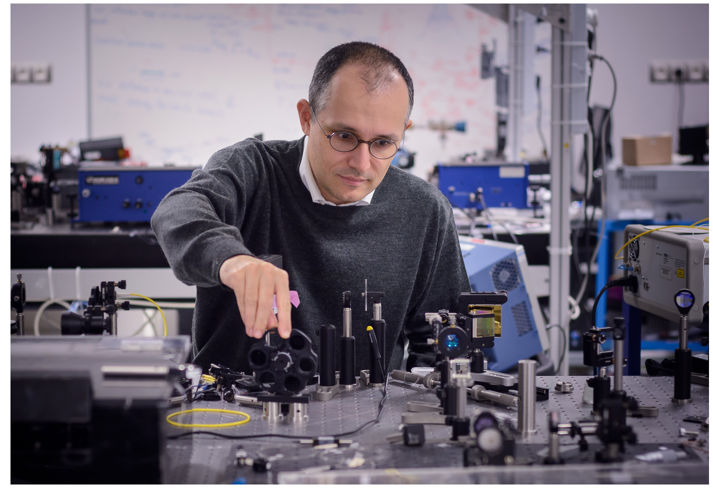
Following this achievement, the researchers demonstrated various 3D optical elements directly inside silicon, such as lenses, waveguides and holograms. Inspired by the successes of “on-chip” devices on various materials, they introduced the term “in-chip” as a shorthand descriptor for this new class of devices.

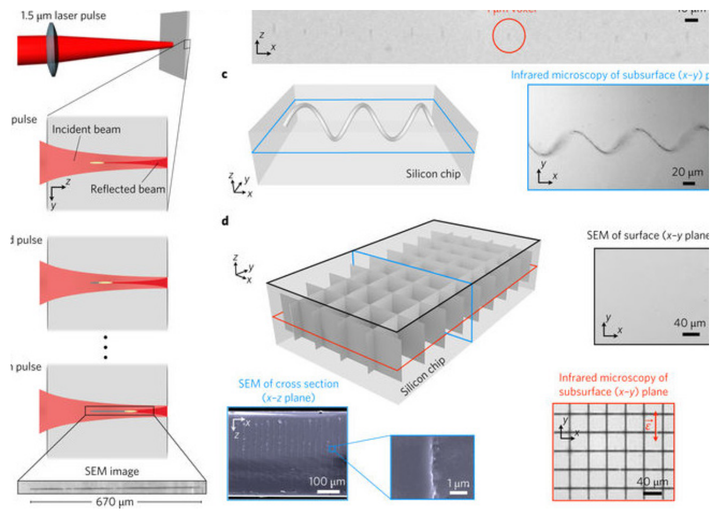
A further outcome is related to 3D printing or sculpting. The researchers found that by exposing the laser-modified areas to a chemical etchant, 3D sculpting of the entire wafer is possible. “I should note that this is a direct laser-writing approach, without the use of masks – inexpensive compared to alternative methods,” notes Dr. Serim Ilday, also of UNAM and one of the coauthors of the paper.

“The possibilities are endless. It’s likely that the method will enable entirely new in-chip devices, such as Si-photonics components, or meandering microfluidic channels that could be used to efficiently cool electronic chips,” observed Prof. Ömer Ilday, another coauthor of the paper and member of the Electrical and Electronics Engineering and Physics departments and UNAM. “As a matter of fact,” he continued, referring to follow-up studies the team is working on, “we have already started to develop new in-chip architectures and functionalities, such as waveguides and laser slicing of wafers.”

Researchers demonstrate fabrication of in-chip microstructures and photonic devices using by nonlinear laser lithography technique

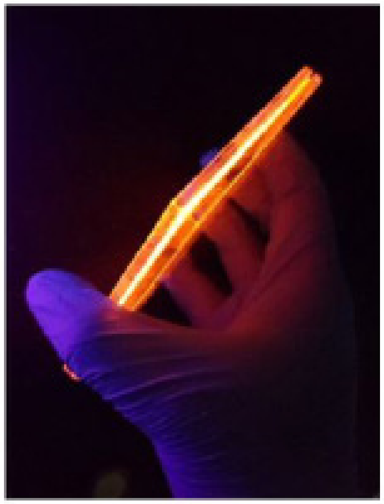
Silicon is an excellent material for microelectronics and integrated photonics with untapped potential for mid-infrared optics. Despite broad recognition of the importance of the third dimension current lithography methods do not allow the fabrication of photonic devices and functional microelements directly inside silicon chips. Even relatively simple curved geometries cannot be realized with techniques like reactive ion etching. Embedded optical elements electronic devices and better electronic–photonic integration are lacking. Here, we demonstrate laser-based fabrication of complex 3D structures deep inside silicon using 1-μm-sized dots and rod-like structures of adjustable length as basic building blocks. The laser-modified Si has an optical index different to that in unmodified parts, enabling the creation of numerous photonic devices. Optionally, these parts can be chemically etched to produce desired 3D shapes. We exemplify a plethora of subsurface—that is, 'in-chip'—microstructures for microfluidic cooling of chips, vias, micro-electro-mechanical systems, photovoltaic applications and photonic devices that match or surpass corresponding state-of-the-art device performances.

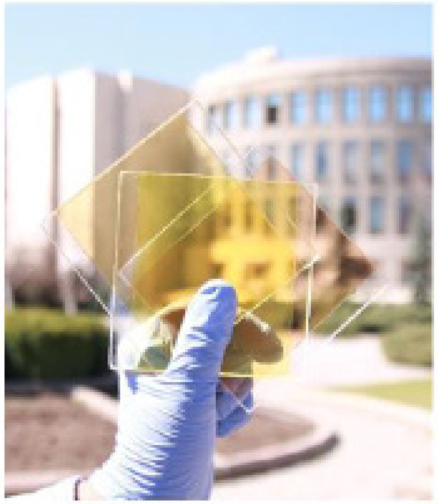


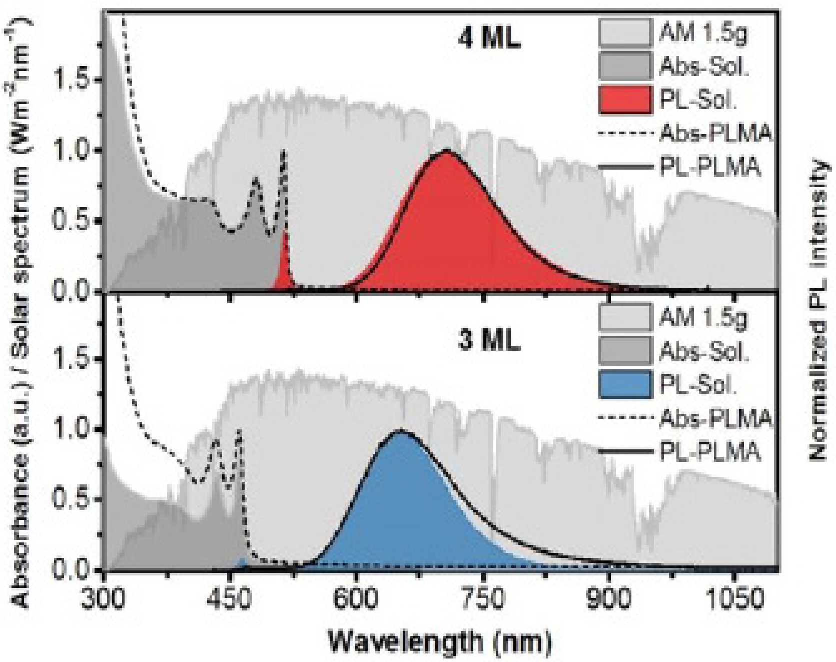


This work is published in the journal of Nature Photonics 25 July 2017 DOI: 10.1038/s41566-017-0004-4

Researchers demonstrate near-unity emitting copper-doped colloidal semiconductor quantum wells for luminescent solar concentrators



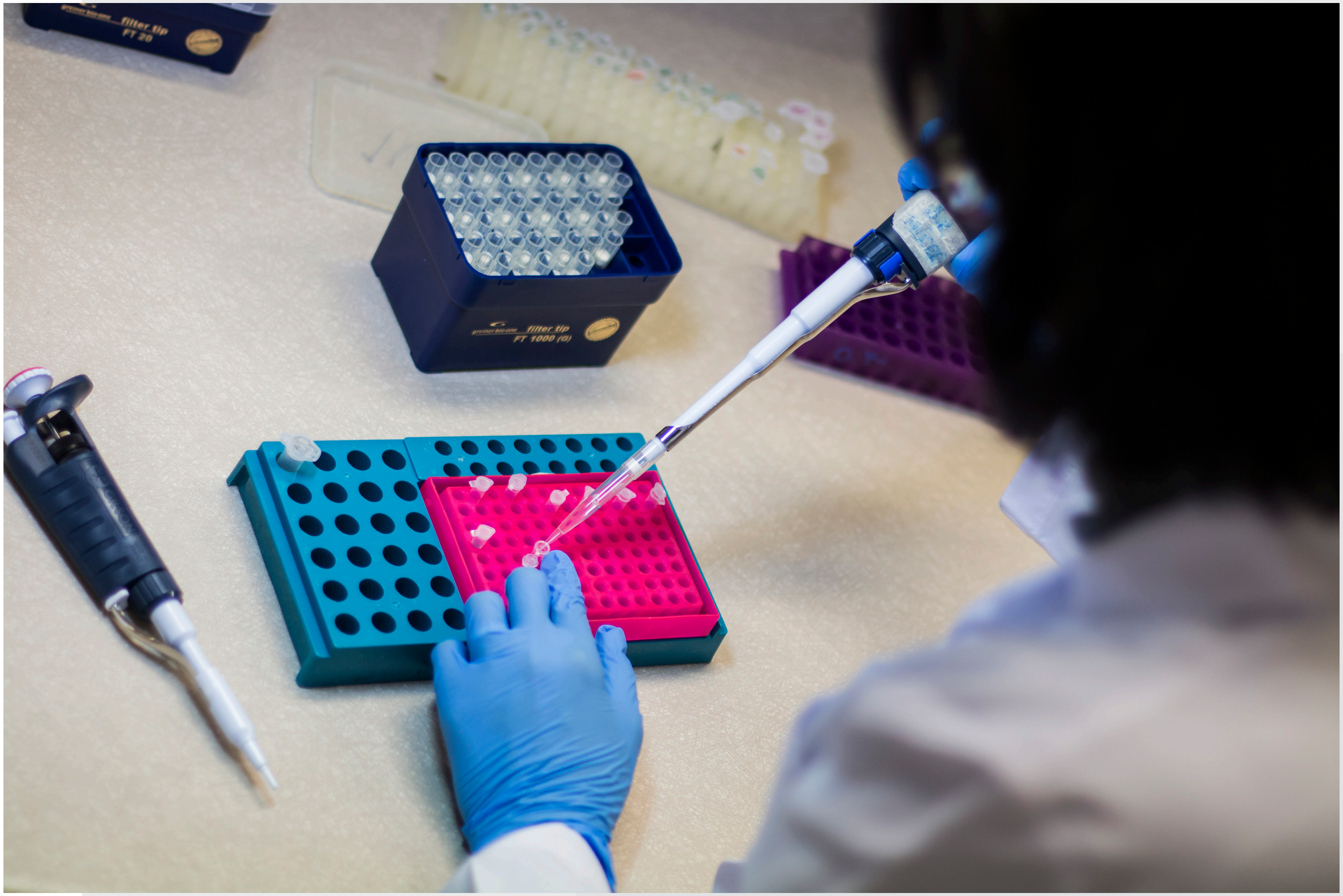




Since the first demonstration of the colloidal quantum dots (CQDs), doping has been widely investigated in the quantum confined semiconductors. In colloidal nanocrystals, doping enables the means for tailoring the electronic structure and optical properties in addition to size, shape and composition tuning. Recently, luminescent solar concentrators (LSCs) based on doped CQDs have aroused attention as a low-cost alternative for solar energy utilization. Effective use of these doped CQDs in LSCs requires a number of important properties including high photoluminescence (PL) quantum efficiency (QE), tunable solar absorption, and good photostability. Apart from these fundamental necessities for the LSC emitter, it is essential to avoid the suffering of the captured photons in the waveguide from various scattering and reabsorption losses.

In a recent communication published in Advanced Materials, a team of researchers led by Prof. Hilmi Volkan Demir, Department of Electrical and Electronics Engineering and Physics and UNAM, have successfully demonstrated the first account of doping into colloidal quantum wells. According to Prof. Demir, the Cu-doped CdSe quantum wells (CQWs) in principle can overcome the above-mentioned limitations in the LSCs with their strong quantum confinement in 1D owing to their magic sized vertical thicknesses. In addition to Stokes-shifted and tunable dopant-induced photoluminescence emission, the copper doping into CQWs enables them with near-unity quantum efficiencies (up to ~97%), substantially high absorption cross-section and inherently step-like absorption profile. Furthermore, by using both experimental analyses and numerical modeling these doped CQWs are shown to be excellent candidates for LSCs. Prof. Demir emphasized that the present work provides a solid platform for applying doping concepts in 2D colloidal quantum wells, which can be extended into different dopant/core and new 2D architectures for future solar light harvesting applications.

This work is published in the journal of Advanced Materials 11 August 2017
DOI: 10.1002/adma.201700821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Researchers demonstrate polymeric nanofiber-based hierarchical reduced graphene oxide hybrid as an effective adsorbent

UNAM researchers showed a hierarchical form polymeric web using graphene oxide (rGO) functionality for the effective adsorption of pollutants in waste water under the supervision of Assoc. Prof. Tamer Uyar of MSN and UNAM. This work shows the surface functionality of reduced graphene oxide over the electrospun polymer surface as an absorber in pollutant based waste water treatment. From the observed results, one develop a hierarchical membrane surface with controlled surface features as an effective absorber.

This cover image of the issue uses the scanning electron microscopy image of polymeric nanofibers decorated with the rGO nanoflakes fabricated from the combination of electrospinning and surface functionalization process. The unique arrangement innovates the proposed approach on the effective adsorption of pollutants from the wastewater. The hierarchical arrangement of rGO-polymeric nanofibrous membrane based hybrid system is initiated for the environmental remediation, and it is believe that these hierarchical platforms can play a key role multifunctional application in the field of filtration, catalysts, sensors and electronics, with and easy manipulation and long-term stability. The morphological image (SEM image of rGO nanoflakes onto electrospun polymeric nanofibers) has won the Materials Today cover competition 2017.

This image is featured as a cover image in Material Today, July-August 2017, can be accessed at the following address: http://dx.doi.org/10.1016/j.mattod.2017.06.006


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ULUSAL NANOTEKNOLOJİ ARAŞTIRMA MERKEZİ
MALZEME BİLİMİ VE NANOTEKNOLOJİ ENSTİTÜSÜ

INSTITUTE OF MATERIALS SCIENCE AND NANOTECHNOLOGY FACULTY MEMBERS

INSTITUTE OF MATERIALS SCIENCE AND NANOTECHNOLOGY FACULTY MEMBERS

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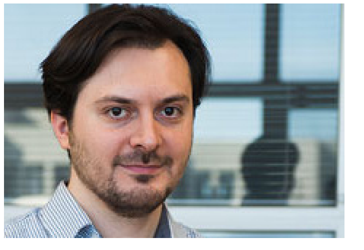
Seymur Cahangirov



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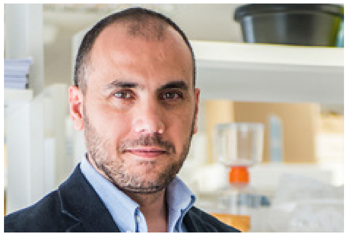
Çağlar Çekiç



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Research interests: Heterogeneous Catalysis and Photocatalysis, Nanomaterials for Energy Storage & Conversion, Environmental Catalysis, Renewable Energy Systems, Spectroscopy and Surface Science

Özgür Şahin

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Research interests: Systems biology of drug resistance and metastasis

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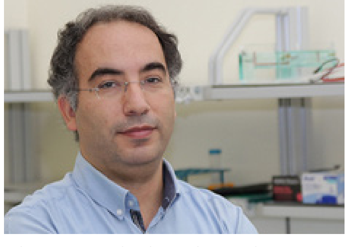
Research interests: Layer-by-layer deposition and their antibacterial applications, electrical investigation on nano-scale structures with dynamic XPS, tribochemistry investigation of various materials, wettability of surfaces

Urartu Şeker



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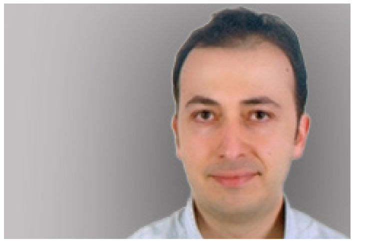
Research interests: Synthetic biology, genetically engineered organisms/biodevices, genetic engineering and protein engineering at the bio-nano interface, medical biotechnology

Onur Tokel



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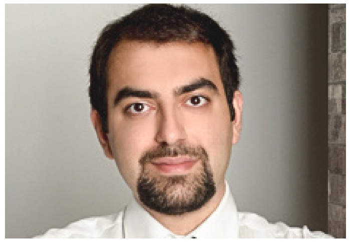
Research interests: Design and synthesis of novel organic and inorganic/organic hybrid, nanostructured functional materials with potential applications in the areas of photonics, photocatalysis and bionanotechnology

Yunus Emre Türkmen



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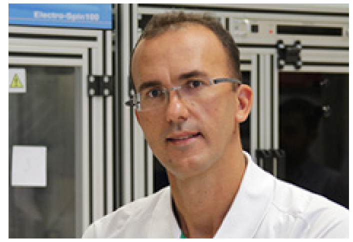
Tamer Uyar



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Research interests: Statistical Physics, Special Optical Beams and Fiber Optics, Plasmonics, Force Measurements at the Nanoscale, Total Internal Reflection Microscopy, Optical Manipulations and Photonic Force Microscopy

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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

Semiha Yılmazer

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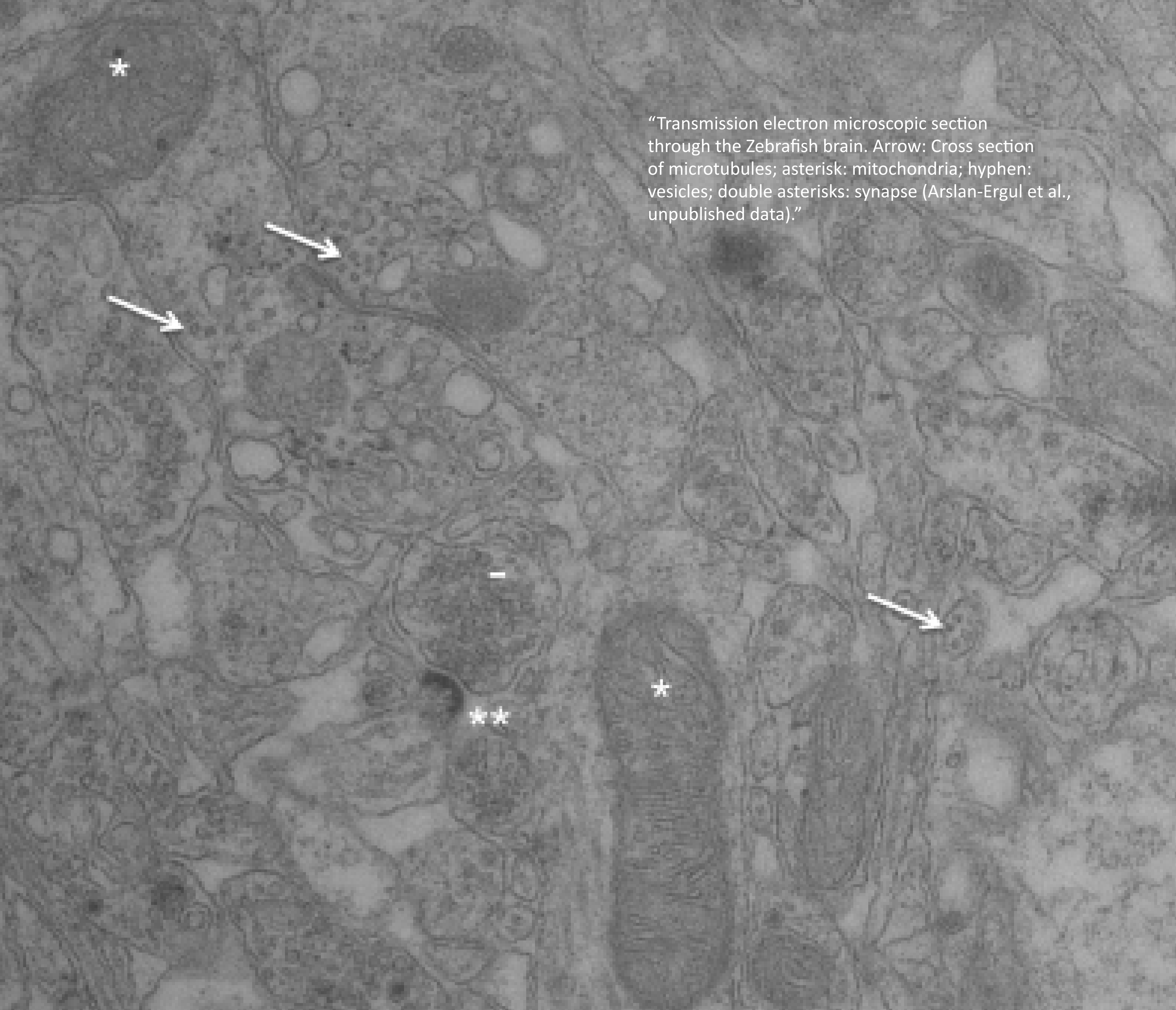
Research interests: Building physics, physical and mechanical properties of building materials with particular emphasize on acoustics, thermal and humidity behaviours, building construction, room acoustics, architectural lighting.

UNAM RESEARCH GROUPS

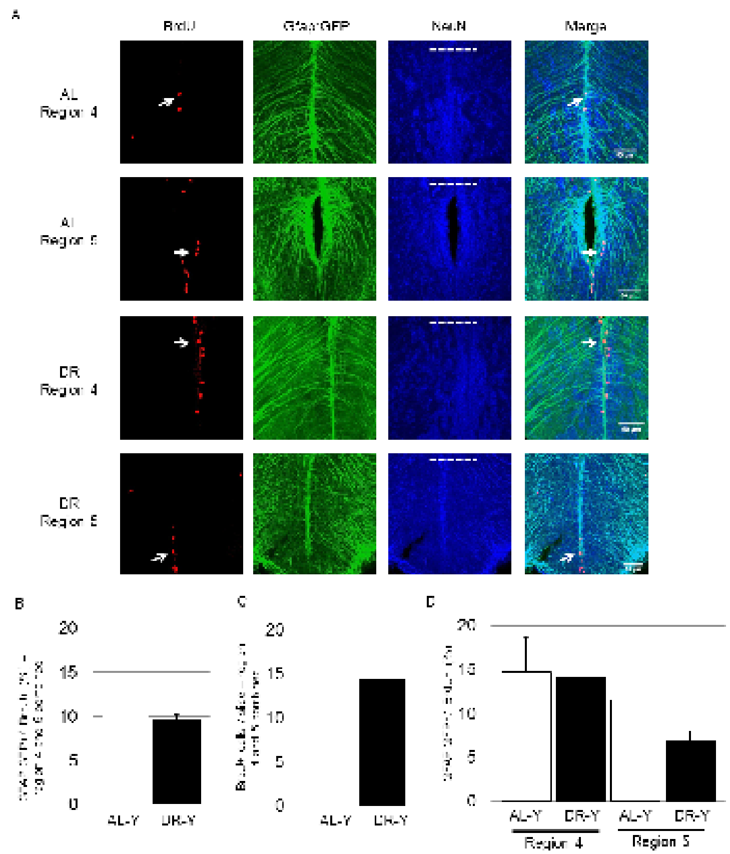


“Transmission electron microscopic section through the Zebrafish brain. Arrow: Cross section of microtubules; asterisk: mitochondria; hyphen: vesicles; double asterisks: synapse (Arslan-Ergul et al., unpublished data).”

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 zebrafish 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. 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.



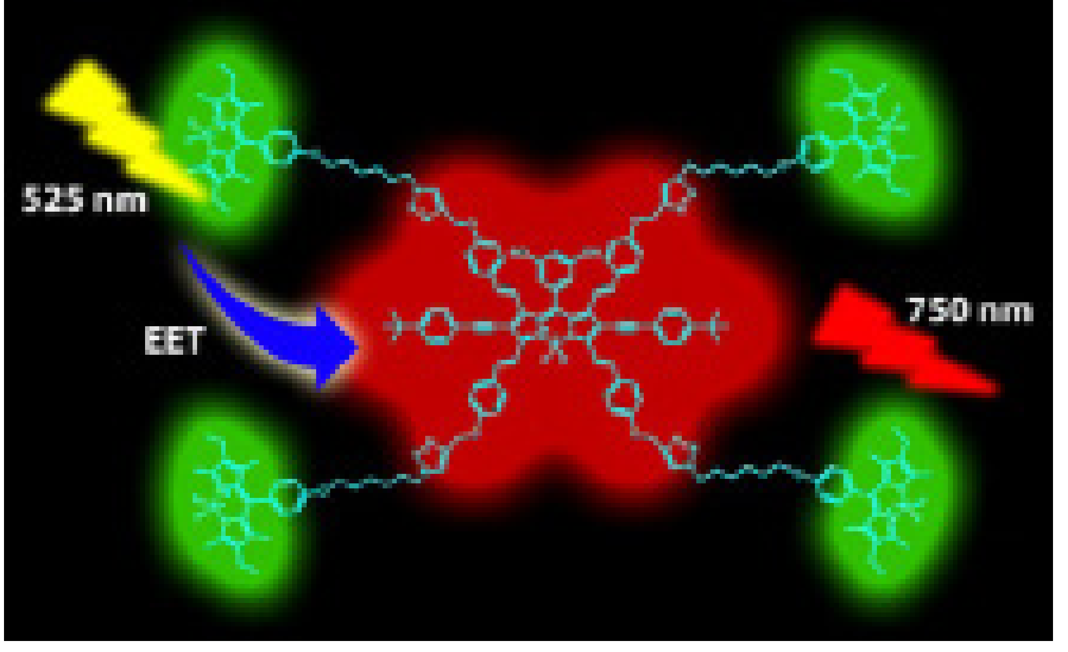
Dr. Engin Umut Akkaya

Supramolecular Chemistry and Chemical Nanotechnology

Rational design of molecular or supramolecular structures with emergent functionalities is the primary target of our research efforts. To that end, we are trying to find practical applications for molecular logic gates, develop autonomous activation protocols for biologically active organic compounds and photochemically modulate various chemical and physical properties of molecular systems.

Our research group has contributed to the development of molecular logic gates over the years. We, among a few others are convinced that the first unequivocal application will present itself in the nanomedicine field. One particular field of inquiry which could benefit from such fusion of ideas is photodynamic therapy. Photodynamic therapy (PDT) is a noninvasive method of treating malignant tumors and age-related macular degeneration, and is particularly promising in the treatment of multidrug-resistant tumors. The PDT strategy is based on the preferential localization of certain photosensitizers in tumor tissues upon systemic administration. The sensitizer is then excited with red or near infrared (NIR) light, generating singlet oxygen ($^1O_2$) and thus irreversibly damaging tumor cells. One important aspect is the tight control of the delivery of cytotoxic singlet oxygen to be produced. In an earlier design, we proposed a sensitizer which behaves as an "AND" logic gate. Singlet excited state of the sensitizer dye can take a number of different paths for de-excitation, through competing processes. Among these processes, photoinduced electron transfer (PeT), intersystem crossing, fluorescence, non-radiative de-excitation are the most prominent ones. The rates of fluorescence or non-radiative process are not affected by the modulators such as Na^+ and H^+. But, the blocking of PeT by Na^+ binding to the crown ether moiety, leaves intersystem crossing as the major path for de-excitation. This is path for singlet oxygen generation. So, increasing concentration of Na^+ ions increases the rate of singlet oxygen generation. H^+ ions influence the same rate by a different mechanism, the added acid causes a bathochromic (red) shift in the absorption spectrum. This shift moves the absorption peak to the peak emission wavelength of the LED used in the excitation. Thus, the sensitizers are more effectively excited when the medium is acidic. Although this is a proof of principle study, we already established the fact that, molecular logic holds a greater promise than previously recognized.

"A convincing application" is sorely missed in the field of molecular logic gates. In most examples, the assignment of logic gates, especially in more complex systems, is "ex post facto", resting on finding a suitable digital design that is in accordance with spectral changes. We design independently functional logic gates and then cascade (or integrate) them by a singlet oxygen signal. In addition, the resulting cascaded gates function in nanospace (inside a micelle) as a singlet oxygen generator, which also reports the rate of singlet oxygen generation. This has clear therapeutic implications within the context of photodynamic therapy.

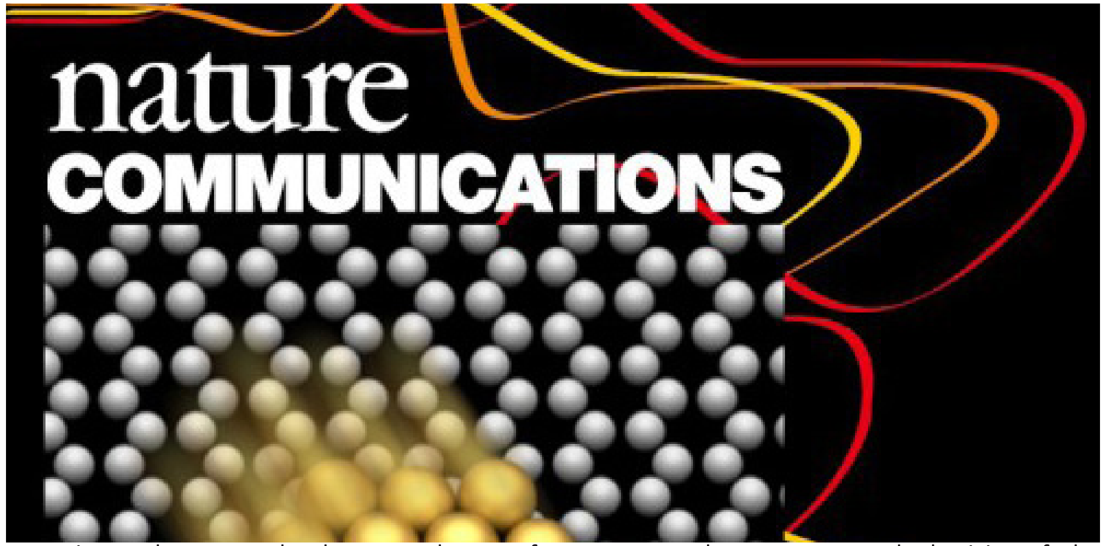


“Scanning probe microscopy provides a unique window to the atomic-scale world of surfaces, through which fundamental processes associated with diverse phenomena such as friction and catalysis may be observed.”

Dr. Mehmet Z. Baykara

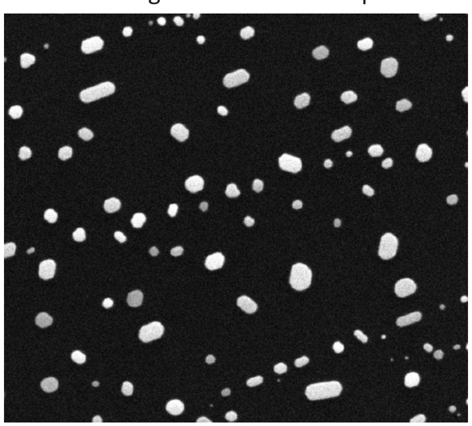
Scanning Probe Microscopy

Various phenomena of scientific and technological importance such as friction, adhesion, corrosion, and heterogeneous catalysis take place at material surfaces. A full understanding of the fundamental principles governing such processes requires detailed knowledge of the nanoscale structural, mechanical, physical, and chemical properties of the surfaces involved. In our research group, we apply and further develop scanning probe microscopy techniques to study a variety of material surfaces and associated phenomena on the nanoscale.



Nanotribology

Despite the fact that friction is ubiquitous in our daily lives, the fundamental physical laws that govern it are still not well understood. Motivated by the idea that an ability to predict and control friction on macroscopic scales depends on a complete understanding of frictional processes occurring at the nanoscale, the research area of nanotribology (the science of friction, wear, and lubrication on the nanoscale) has been formed.



In our research group, we study (i) the frictional properties of two-dimensional materials such as graphene and (ii) the nanotribological behavior of metallic nanoparticles on substrates such as graphite by atomic force microscopy based experiments. By studying friction as a function of interface structure and chemistry, we contribute to the further development of friction laws on the nanoscale. In particular, we have recently discovered the occurrence of structural lubricity for the first time under ambient conditions and the related results have been published in Nature Communications.

Probe Effects in Atomic Force Spectroscopy

Despite the vast potential of scanning probe microscopy in exploring the atomic-scale physical properties of material surfaces, issues such as structural asymmetry and elasticity of the probe apex as well as cross-talk in multichannel experiments cause significant problems in correct interpretation of results.

In our research group, we utilize numerical simulations to study effects associated with tip structure and elasticity in atomic-resolution scanning probe microscopy experiments. In particular, we have recently verified that erroneous conclusions about atomic-scale surface properties can be readily drawn on samples such as graphene when asymmetric and soft probe tips are utilized during combined atomic force/ scanning tunneling microscopy measurements.

Dr. Bilge Baytekin

Mechanochemistry

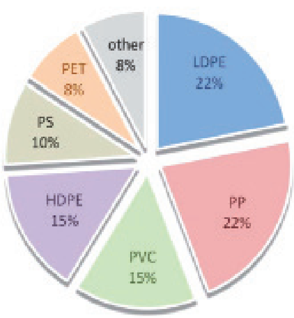
In our research group, we develop new materials and methods to efficiently convert mechanical energy to chemical energy.

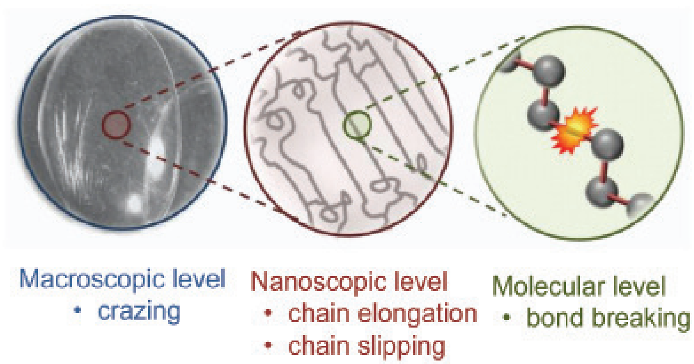
Mechanochemistry

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.

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.





Polymer mechanochemistry: versatile and efficient. In the figure: A Nike Air shoe sole filled with a pre-florescent dye fluoresces upon walking.

"Revealing physical and chemical changes on the surfaces at the molecular level help us to find solutions to the problems such as static electricity, friction and wear."

Triboelectricity and Tribochemistry

The research interest of our group consists of all electrical, physical, and chemical changes that happen when surfaces get into contact. We examine, analyze and tailor surfaces at molecular and nano level to effect their properties in the macro dimensions and reflect these on applications in the various technologies e.g. electronics, air-space, and polymer manufacture. Our state-of-the art research aims to find answers to scientific questions that have been asked for centuries, as well as to produce valuable products using these answers.

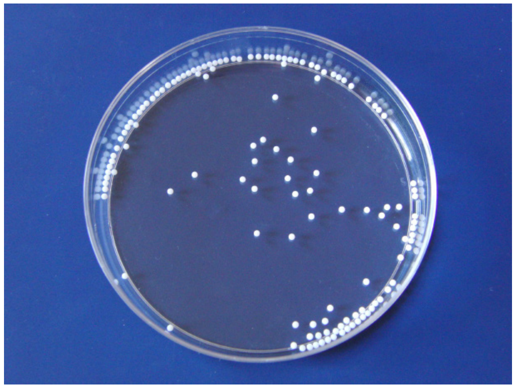
Triboelectricity of Polymers

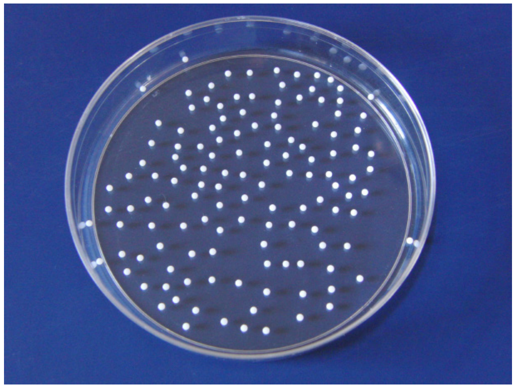
Polymers are the most encountered materials in our everyday life with a rapid growth of utilization. The versatility of the uses of polymers, from spacecrafts to ordinary plastic bags, the variety of chemical and physical properties and their dependence on environmental conditions hinder a better understanding of the electrical behavior of the (dielectric) polymer surfaces. Nevertheless, we have recently shown that it is possible to build a systematical understanding of electrical properties of polymers, especially on their electrostatics, and to find a way to control electrification successfully.

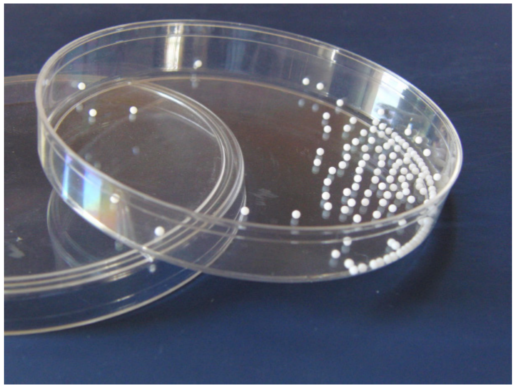
It is a millennia-old problem to understand the electrification of insulators. Our group contributes largely in finding out solutions for this question on the fundamental basis. Moreover, we develop new methods based on this knowledge to mitigate polymer electrification. These methods can be useful in many technologies, where polymers get into play, such as textile, plastic manufacturing, air and space industries.

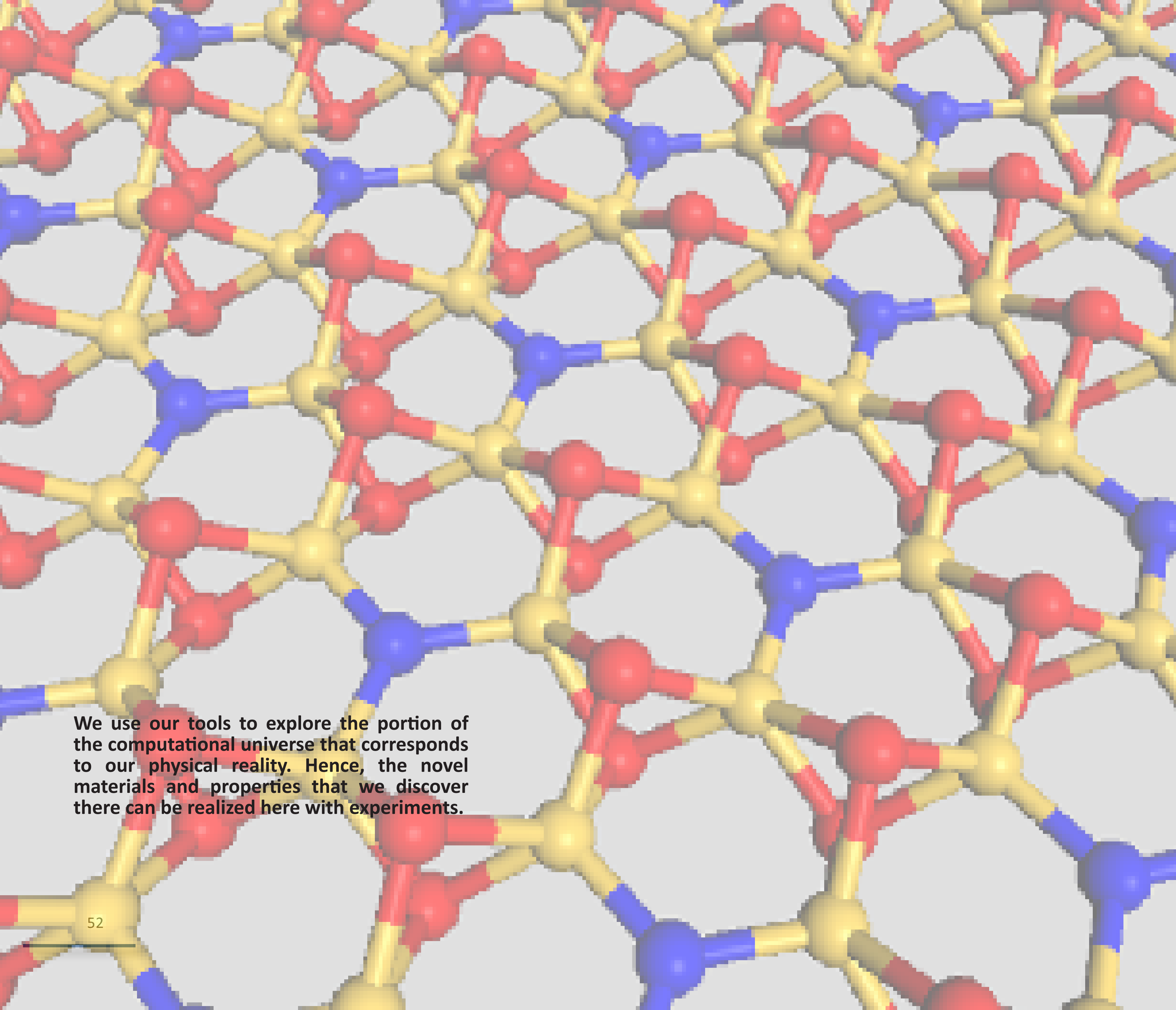
Tribochemistry

On every contacting surface chemical changes take place, depending on the nature of contact. These changes cause many problems and economical loses in industry e.g. in automotive industry. In our group, we also work on preventing these losses and to increase efficiency of work done by such surfaces.









We use our tools to explore the portion of the computational universe that corresponds to our physical reality. Hence, the novel materials and properties that we discover there can be realized here with experiments.

Dr. Seymur Cahangirov

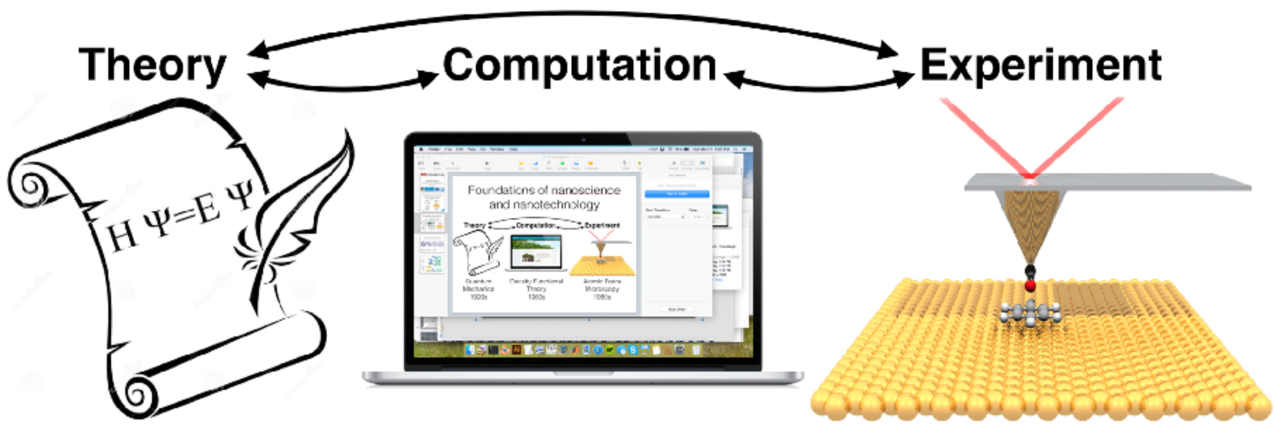
Computational Modeling

Employing the state-of-the-art tools developed for computational condensed matter physics we investigate atomic, electronic, mechanical, thermal and other properties of novel low-dimensional materials. These include two-dimensional (2D) materials, like graphene, silicene, germanene, metal dichalcogenides, and one-dimensional (1D) materials, like atomic chains, nanotubes, nanoribbons and nanowires.

We live in a mathematically consistent physical universe. For centuries, we improved our understanding of the universe by developing mathematical models (theories) or physical probing devices like telescopes or microscopes. In the last few decades, with increasing computational power, we started to think about everything in terms of information. To his end, we now consider the possibility of our universe being just one of the infinitely many universes woven with mathematical consistency out of information fabric. Nowadays, we use computers to probe the universe at all scales, ranging from atoms to galaxies. Computation become a crucial tool bridging the gap between theoretical and experimental studies.

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 via implementation of elegant theories, like the Density Functional Theory (DFT), in efficient algorithms that run in powerful supercomputers.

Our physical universe is painstakingly explored by ever stronger telescopes in search of places that can inhabit life. This ambitious search is powered by pure curiosity of humankind and belief in making plans that exceed our current lifetimes by orders of magnitudes. We would like to join this search by exploring the computational universe in search of intelligent life. In addition to our mainstream research described above, we started developing computational models that mimic the most primitive neural circuitries encountered in biological organisms. We collaborate with experts from various disciplines and our models use concepts borrowed from disciplines ranging from statistical physics to machine learning.

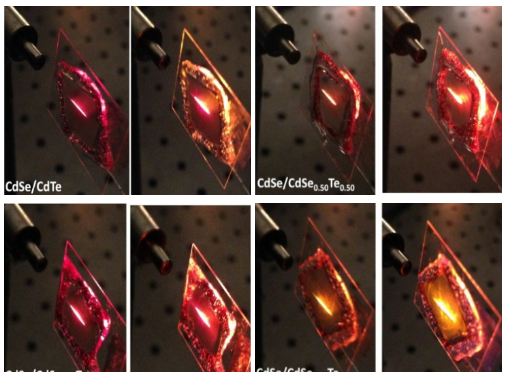


The Demir Research Group is working on innovative quantum material platforms and novel devices embedded with nanoscale functional structures. Under the supervision of Professor Hilmi Volkan Demir, the research group focuses on studying semiconductor optoelectronics of nanocrystals including colloidal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

Dr. Hilmi Volkan Demir

Quantum Materials, Devices and Sensors

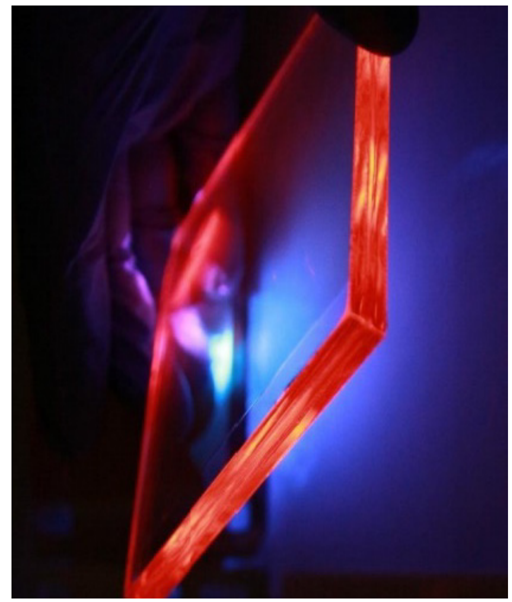
The Demir Group's research work has advanced the scientific knowledge and technology benchmarking in semiconductor nanocrystal lighting. The team works on semiconductor materials spanning from synthesis to property characterization and device applications, including cutting-edge soft-material synthesis, material characterization and device fabrication systems. These studies enable the research group to establish world-class expertise and generate new knowledge and technologies covering from materials to systems, with the targeted applications in color-enrichment for displays, quality indoor lighting, spectrally enhanced outdoor lighting, flexible and bendable displays, and tunable lasers. The team has also developed the capability to synthesize various types of colloidal quantum dots including II-VI and III-V material systems.



High-Efficiency Optical Gain in Alloyed Colloidal Quantum Wells: Colloidal semiconductor nanocrystals offer exciting prospects for optically pumped lasers that can practically emit at any color covering from UV to IR. However, lasers of conventional nanocrystals have been severely limited to date. This mainly stemmed from fast nonradiative recombination processes such as Auger recombination that rapidly deplete gain-active excitonic species before they could contribute to gain. For this purpose, shape-controlled and composition-tuned nanocrystals have been proposed towards low-threshold optical gain via suppressing Auger recombination. Among these, nanocrystals having Type-II band alignment have been promoted, but their performance has been restricted by small modal gain coefficients and short gain lifetimes due to their small transition oscillator strength and low absorption cross-section.

Overcoming these challenges, we accomplished an unprecedented optical gain performance in Type-II nanocrystals by developing an alloyed colloidal quantum well (CQW) architecture. By optimizing the composition of the core/alloyed-crown CdSex/ $CdSe_xTe_{1-x}$ QWs, we realized amplified spontaneous emission with a threshold as low as 26 μJ/cm², accompanied with large net modal gain coefficients up to ~930 cm^{-1} and long gain lifetimes (τ_{gain} ~400 ps). The performance of the Type-II QWs studied here represents more than an order of magnitude improvement over the previous best reports in Type-II NCs. Also, the measured modal gain coefficient is record high among all colloidal semiconductors. Moreover, we corroborated the underpinning mechanism of this efficient gain, which surprisingly arises from the carriers that are localized to the alloyed-crown region. This gain scheme in these alloyed QWs resembles a four-level gain system, which is expected to enable them possibliy for the practical realization of continuous-wave pumped and electrically-injected NC lasers. [J. Phys. Chem. Lett., 2017]

Highly-Efficient, Specially Designed Quantum Materials for Luminescent Solar Concentrators: Luminescent solar concentrators (LSCs) are cost-effective light-harvesting devices for solar light collection and power conversion. In LSCs solar flux is collected by large–area surface and absorbed by the embedded emitters. Reemitted light by these fluorophores is guided through total internal reflection and concentrated toward their thin edges where photovoltaic (PV) cells are applied. Hence, increasing the light collection area in LSCs enables additional concentration of incident solar flux onto PV cells increasing the photo-generated power. Spectrally matching the photoluminescence emission of the fluorophores with the peak



efficiency of a desired PV device further increases the efficiency of LSCs. In this respect, our colloidal semiconductor nanocrystals possibly make excellent LSC fluorophores because of their well-known emission tunability. Among various loss mechanisms reducing the LSC performance, optical reabsorption losses are the most significant, preventing the practical applications of LSCs. Highly Stokes-shifted emission is the key to overcome the reabsorption losses for NCs. For this purpose, we showed that that copper doping in nanocrystals enable the highest performance compared to other colloidal nanocrystal heterostructures. [Advanced Materials, 2017]

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

Dr. Engin Durgun

Computational Nanoscience

We are working in the multidisciplinary field of computational science, which intersects physics, chemistry, and materials science. We focus on the application of state-of-the-art modeling and simulation tools to understand, predict, and design novel materials systems to address critical challenges of global importance. We are particularly interested in investigating 2D materials at the nanoscale, the design of solar-thermal fuel systems, and the study of green and high-performance cement.

2D ultra-thin systems

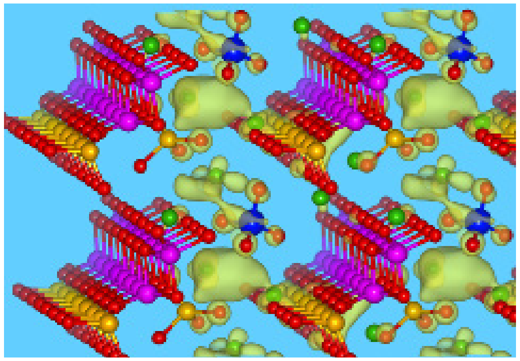
Following the synthesis of single-layer graphene and demonstrations of graphene-based device applications, two-dimensional ultra-thin materials have become the focus of both experimental and theoretical studies. Interesting quantum effects provided by the reduction of dimension of the bulk materials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

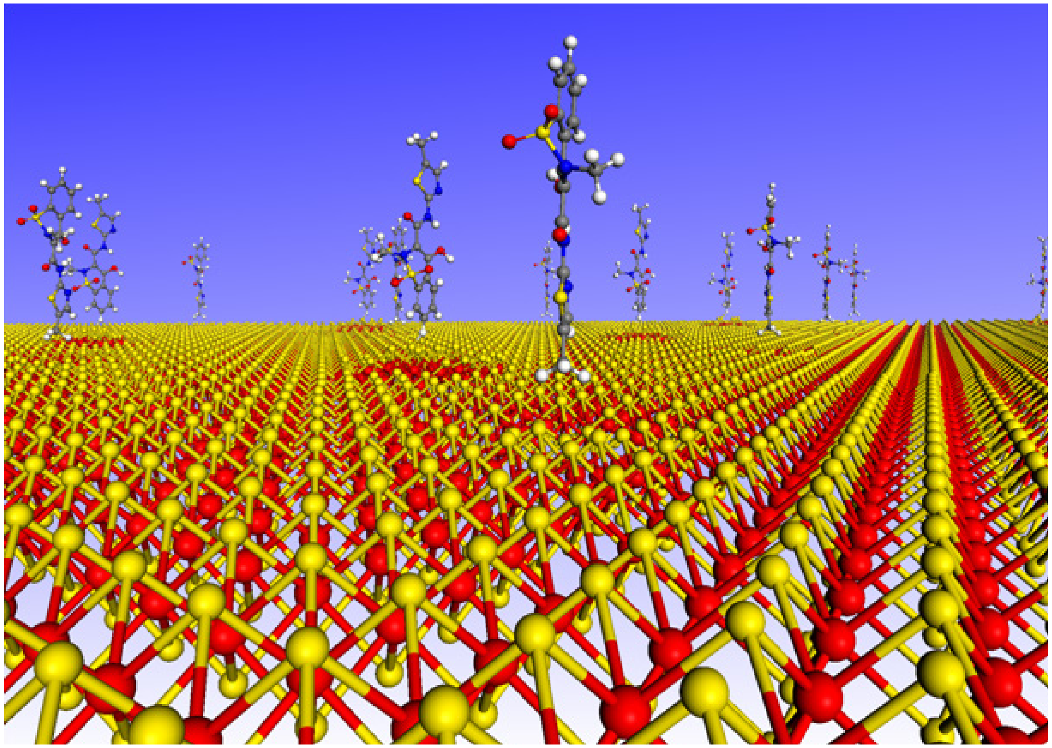
Solar-thermal fuels

Efficient utilization of the sun as a renewable and clean energy source is one of the greatest goals of this century. An alternative and new strategy is to store the solar energy directly in the chemical bonds of photoconvertible molecular systems. We suggest different approaches and ideas to design materials for solar fuel applications and investigate methods to increase the energy storage capacity and life-time of the product.

Green and high performance cement

Cement is the cause of more than 8% of global CO_2 emissions, and yet, while it is one of the most common materials in use, we have remarkably little understanding of its microscopic properties. To reduce the environmental footprint and enhance its performance a greater fundamental understanding down to the scale of its electronic properties is essential and required. We are suggesting a bottom-up approach to modify the properties at the nanoscale for new generation cement.

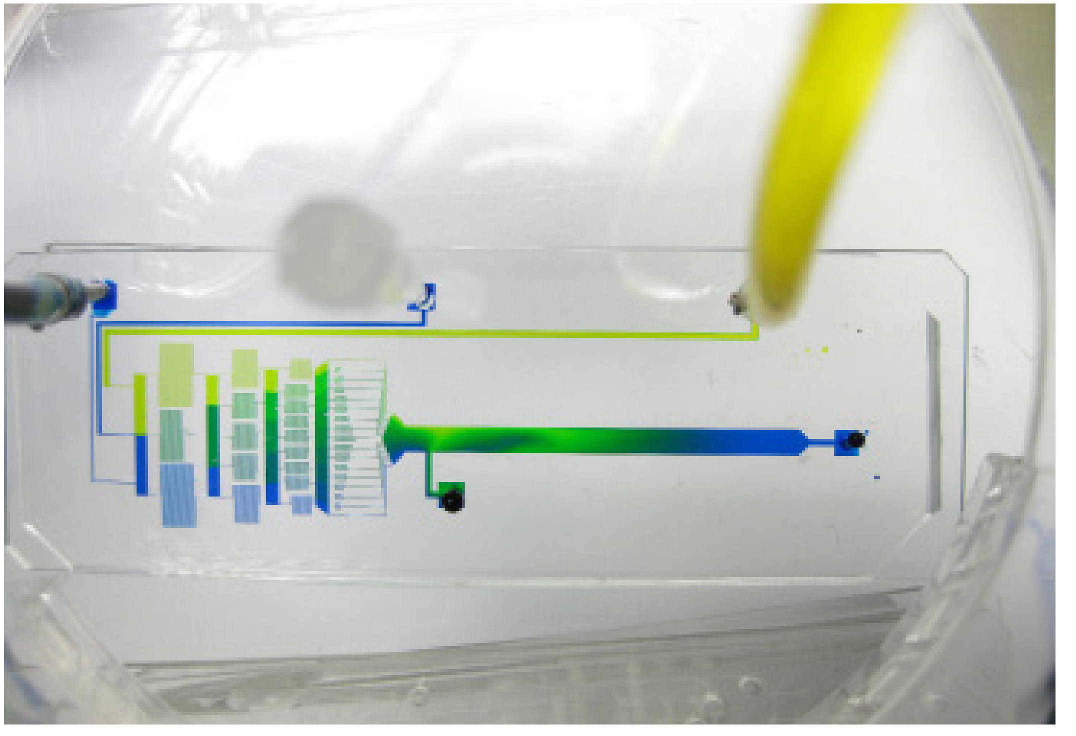




Dr. Çağlar Elbüken

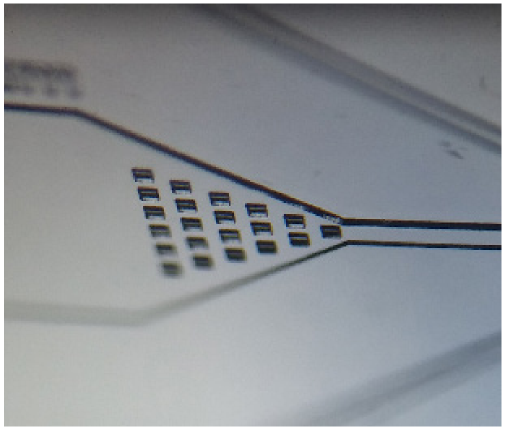
Micro/Nanofluidics and Lab-on-a-Chip Systems

We are working on developing fundamental understanding and applications of fluid flow at small scale. We are specifically interested in control of biological liquids with extreme precision. Exquisite control of nanoliter size fluid packages enables high throughput studies using minute amounts of samples. Such systems address a broad range of applications. We explore applications in single cell studies.



Microdroplet based systems

Recently, we have developed microdroplet based platforms that utilize two phase flow. We are combining these systems with portable electrical sensors for real-world applications. Using these systems we can study viability of biological samples in nanoliter sized microdroplets under different buffer conditions. Integration of these systems with low-cost electronics opens the avenue for rapid diagnostic and screening applications. The system we are developing is especially powerful in assays requiring high througput. The system is reprogrammable, i.e. the size and the speed of the droplets generated can be fine tuned in pico/nanoliter range. The system can be automated to measure the viability of cells in each and every droplet. We are interested in applying this system to study antibiotic resistance of single cells and cell colonies.



Point-of-care diagnostics

We are also working on point-of-care diagnostic devices. Point-of-care devices are becoming more popular due to raising interest in personal health. Development of these systems requires a deep understanding of fundamental fluid flow mechanisms and enabling sensing technologies. Currently, we are working on a mobile platform for detection of cardiac troponin-I, which is a biomarker for rapid diagnosis of myocardial infarction.

“Micro/nanofluidic systems allows us to study biological and chemical processes at very small scale.”


metisafe
Class II Safety Cabinet
Class II Safety Cabinet

Dr. Ebru Erbay

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.

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.

Dr. Yegân Erdem

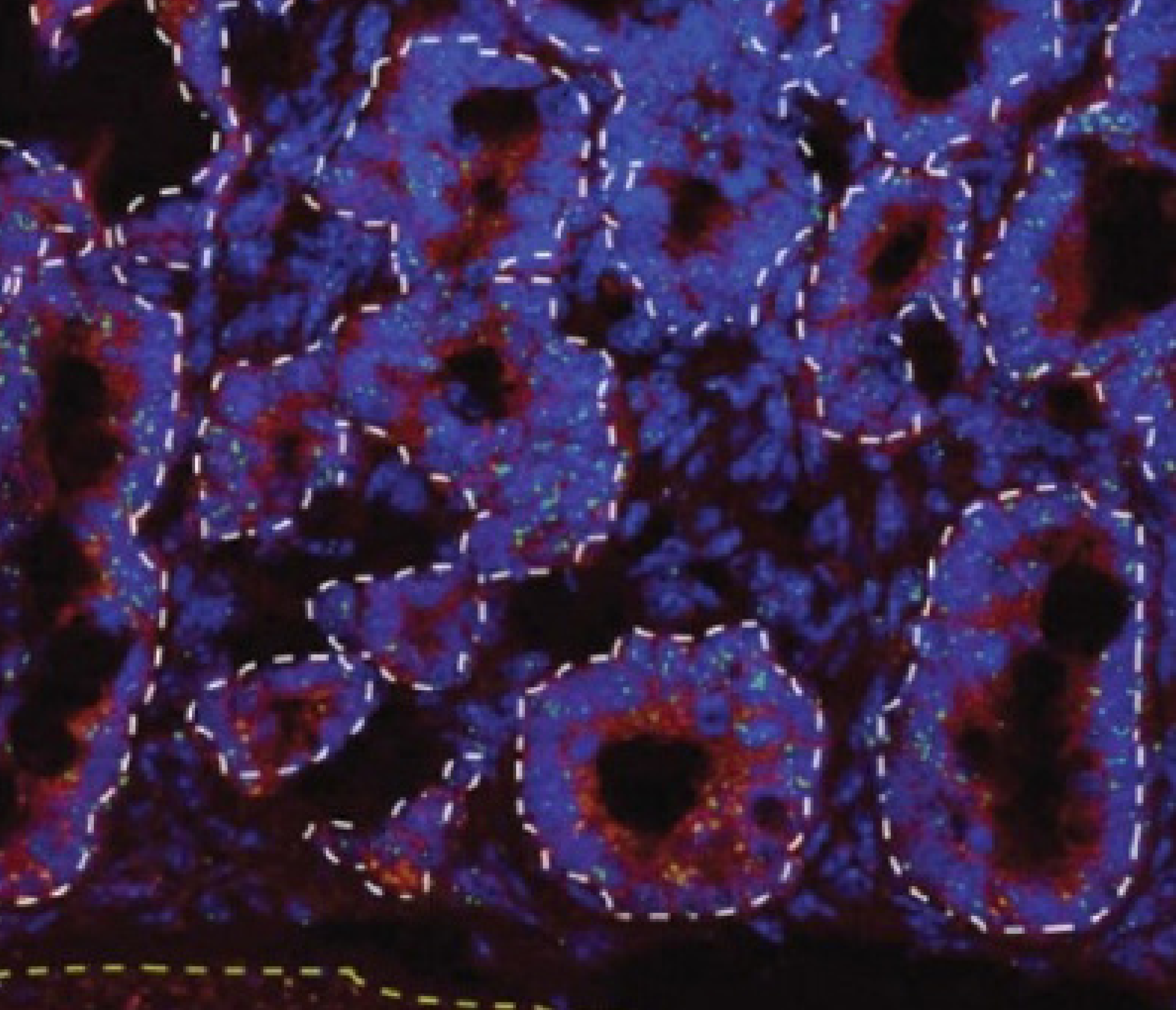
Micro and Nano Integrated Fluidics

Micro and Nano Integrated Fluidics (MINI) focuses on using microfluidics as a tool for nanotechnology applications. The main focus is nanomaterial synthesis, manipulation and printing via microfluidics. Current techniques for nanomaterial synthesis lacks the ability to control reaction conditions, resulting in polydispersity. Microfluidics not only provides a controlled environment for synthesis but also the ability to perform post-processing such as shell coating or functionalization.

MiNI Lab is a research group that brings microfluidic solutions to nanomaterial technology. Nanomaterials such as nanoparticles, nanorods or nanowires, have unique properties that highly depend on their size; therefore it is crucial to be able to perform synthesis reactions with superior control over reaction conditions to achieve monodispersity. Monodisperse particles can be later functionalized and printed on surfaces to form sensors, or other smart surfaces. In MiNI Lab there are two approaches for microfluidic systems for the synthesis and manipulation of nanomaterials. The first one is microchannel based approach, where solvents are passed through channels and synthesis is based on the mixing and heating of these solvents inside the channels. The second approach is the surface approach, where droplets are moved on a textured surface without being enclosed in a channel. By creating local energy gradients on the surface, droplets of liquid can be manipulated by supplying an external energy such as vertical vibration of the surface. With the second approach, nanomaterial synthesis can be realized in small droplets and later these droplets can be carried to specific locations for immobilization and printing.

In the MiNI Lab we plan to develop microfluidic networks for assembling nanomaterials on substrates to create smart surfaces. Nanomaterials can be delivered to specific locations by using a combination of microfluidic channels and textured surfaces. Once they are delivered to the location, the solvent can be evaporated selectively. By using this network, different nanoparticles can be assembled on the same substrate at precise locations. This method is a mechanical way of assembling nanoparticles therefore it is independent of substrate material and does not require chemical modification of the surface. These smart surfaces have two application areas. The first application area is biosensing. Functionalized nanoparticles with biomolecules are used for biosensing applications to enable point-of-care diagnostics. The second promising application area of these smart surfaces is energy harvesting from random mechanical motions.

“MiNI Lab brings microfluidic solutions to nanomaterial technology.”



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. 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)

Nanoelectromechanical Systems

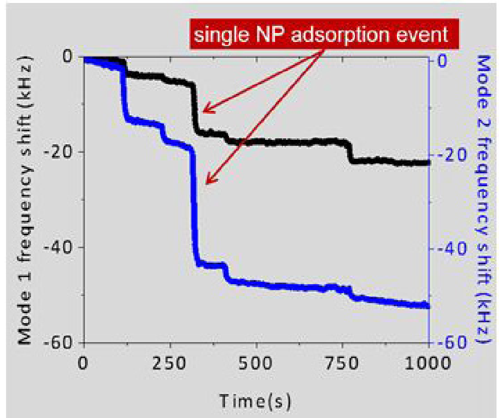
Dr. Selim Hanay

We are engineering ultra-small mechanical machines to develop novel sensor technologies for biological and environmental problems. Thanks to their miniscule size, these sensors are extremely sensitive to physical changes. We are developing NEMS-based mass spectrometry systems that enables chemical analysis at the single molecule level. These small systems have transformative potential for future applications in mobile, biochemical screening.

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.

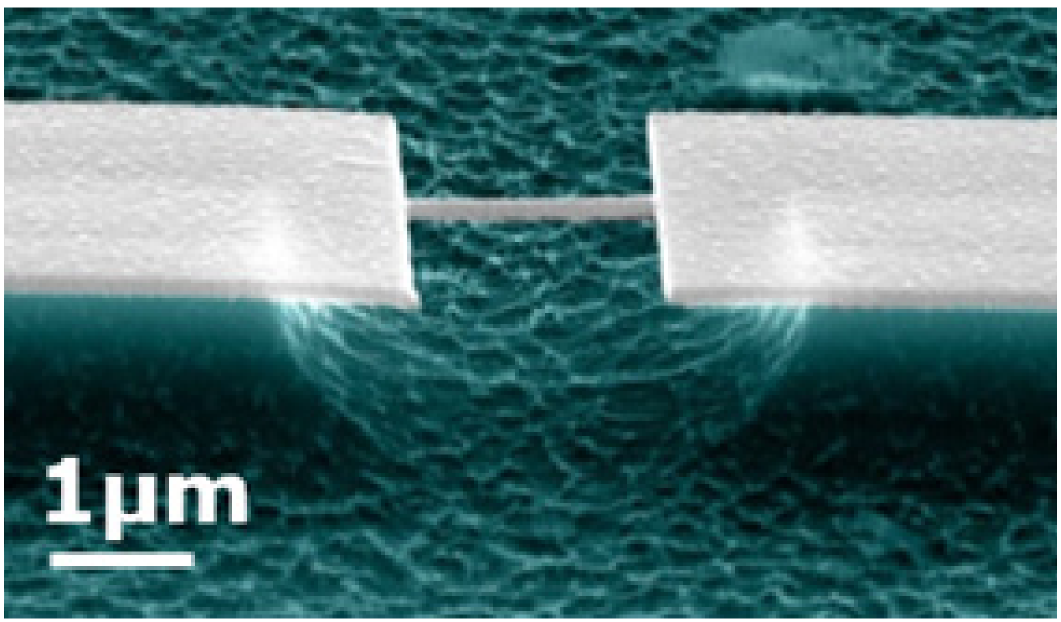
NEMS Mass Sensing and Mass Spectrometry

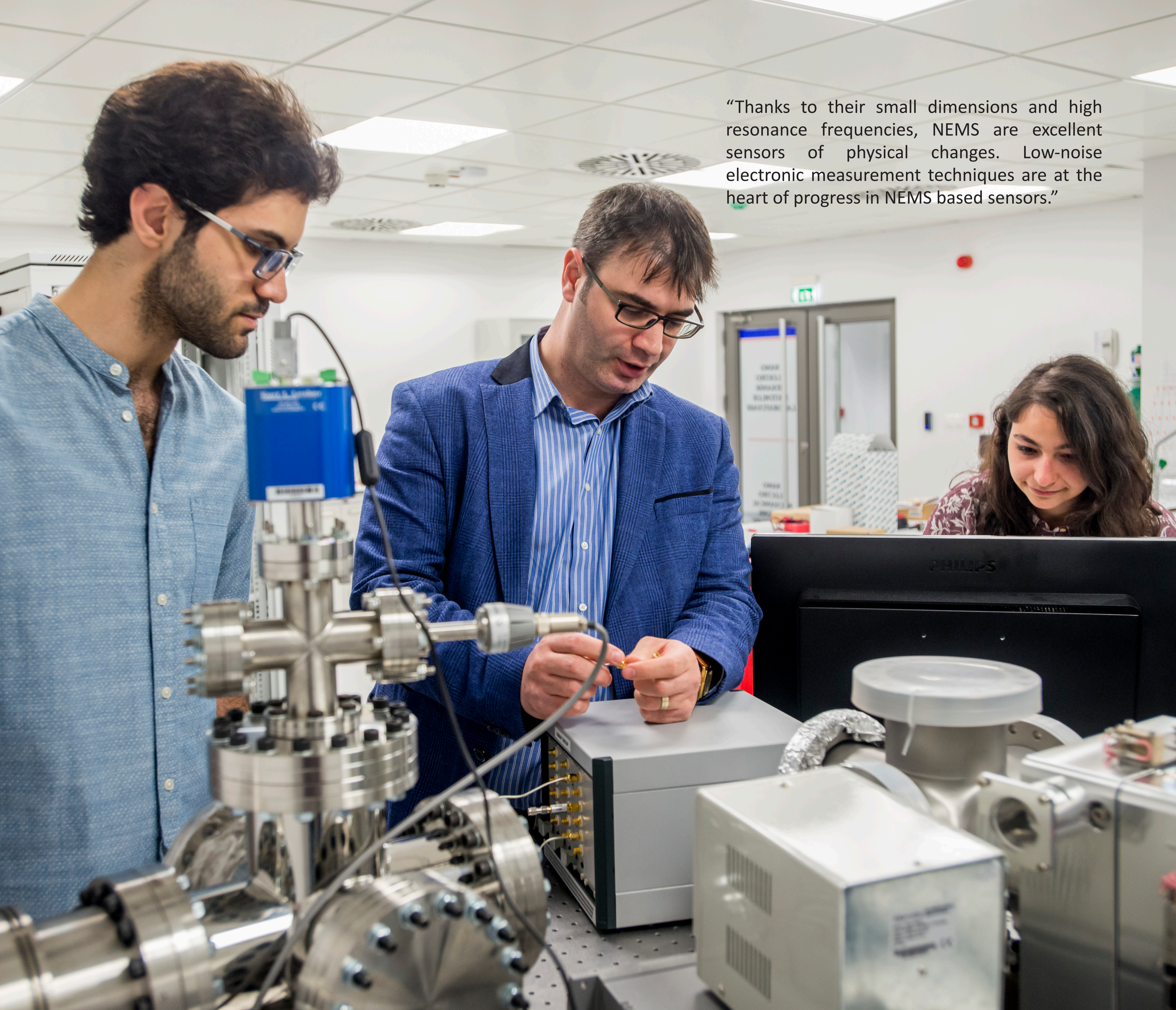
One application of NEMS technology is sensing extremely small masses. Mass sensitivity at the zeptogram (10^{-21} g) scale is possible with top-down fabricated NEMS devices. This level of sensitivity enables the mechanical weighing of single molecules which was demonstrated in 2012. The determination of molecular weight



enables the identification of the molecule and opens up the possibility for chemical identification with NEMS devices.

The operation of NEMS as a mass spectrometer relies on the precise measurements of mechanical resonances. Each mechanical mode of a NEMS device has a specific resonance frequency determined by the effective stiffness and the effective mass of the particular mode. The resonance frequency is continuously monitored in experiments by a specialized electronic circuitry while sample molecules are introduced. Abrupt downward jumps in the resonance frequency are induced when an individual particle is adsorbed by the structure. From the measurement of mechanical frequency shifts, the mass of the added molecule can be determined.





“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.”

Dr. Ferdi Karadaş

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 H_2 Storage

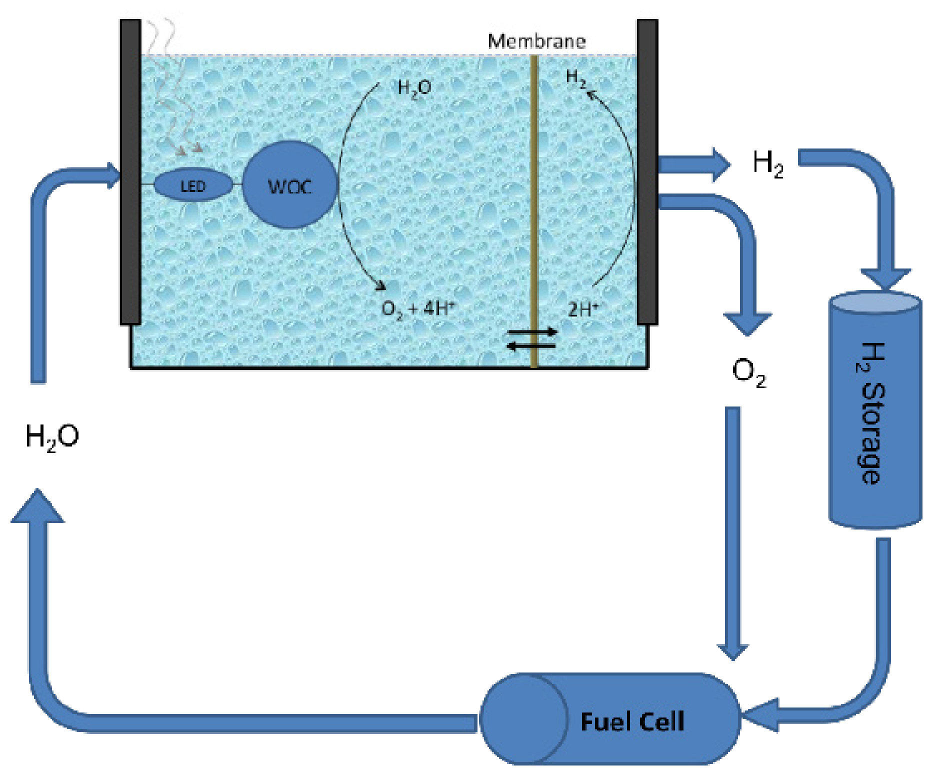
Solid adsorbents that could physically adsorb hydrogen are one of the most promising class of materials since they are robust at extreme conditions and their regeneration energy is negligible. Preparation and investigation of solid adsorbents that exhibit high performance at ambient conditions is the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

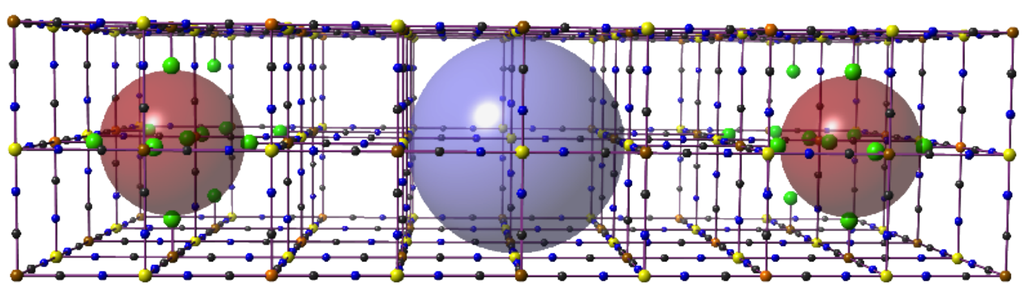
Coordination Compounds for Water-oxidation Catalysis – Artificial Photosynthesis

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.





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."

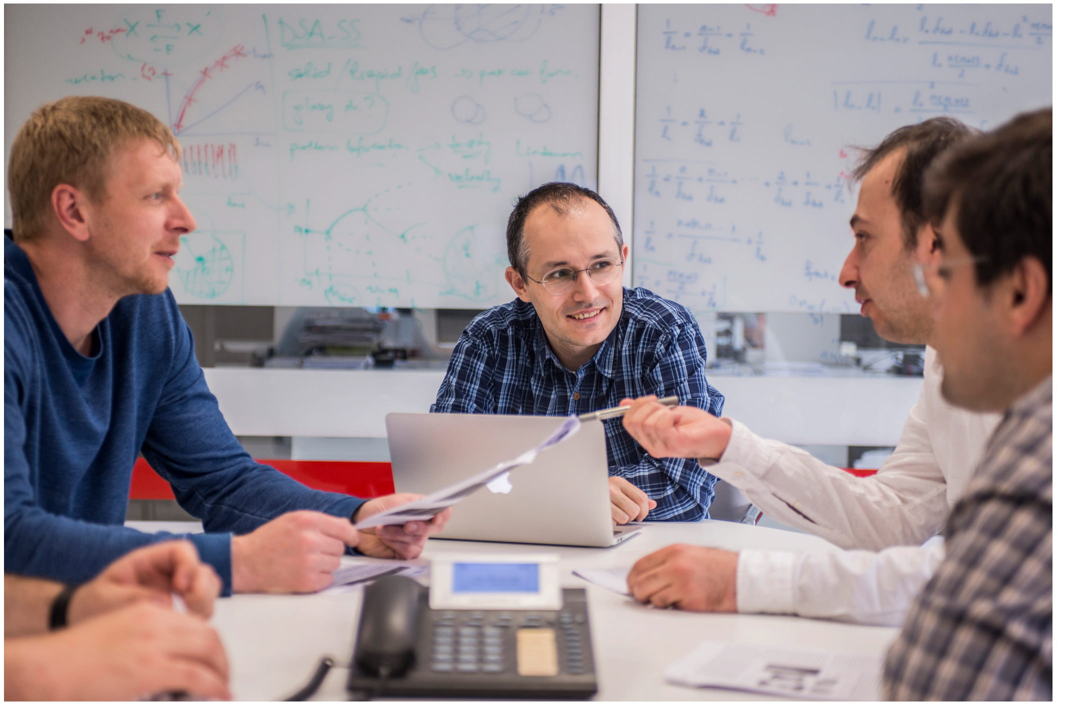
Dr. F. Ömer İlday

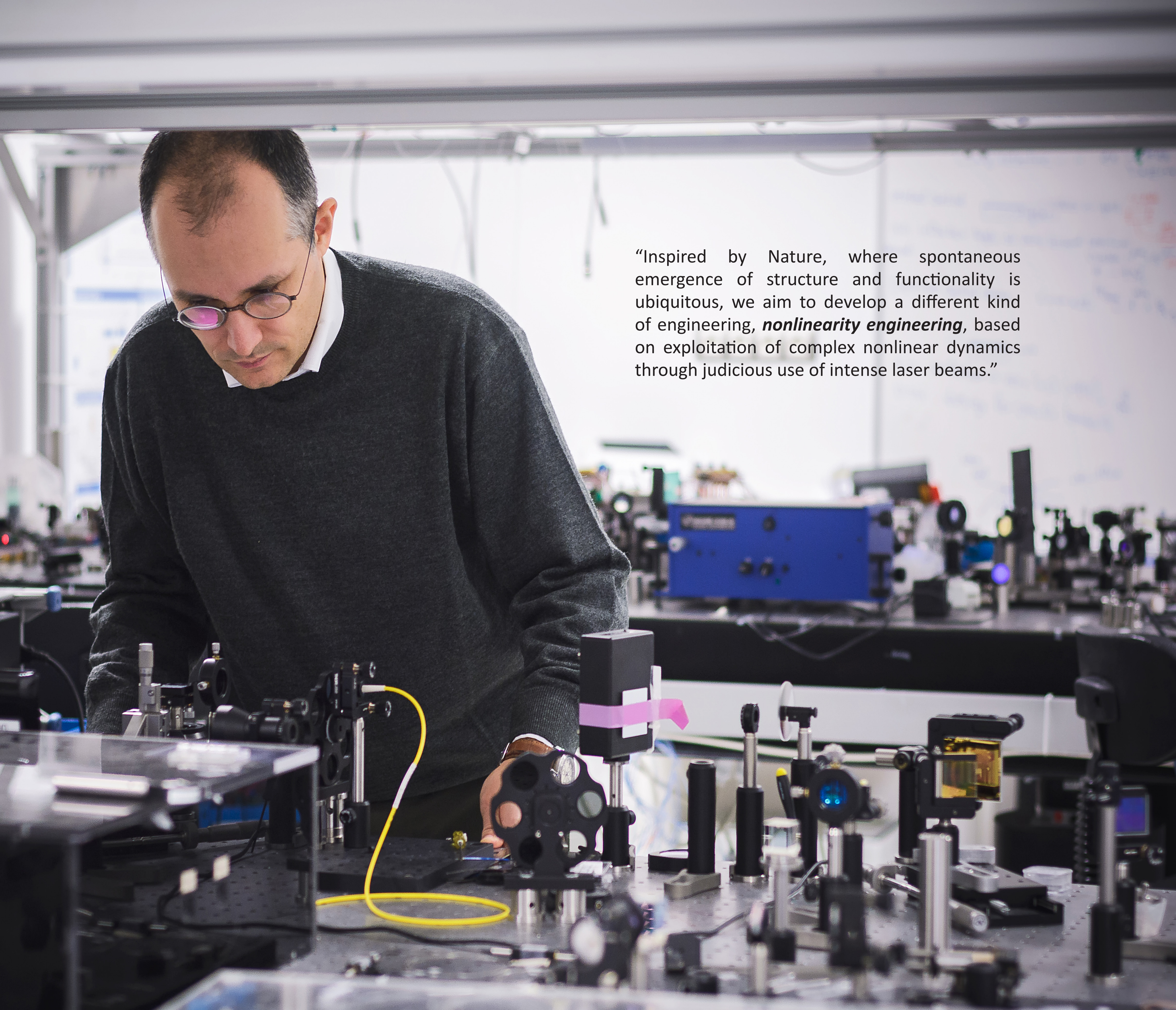
Laser-induced Fabrication of Self-organized Nanostructures

Control of matter via light has always fascinated mankind; not surprisingly, laser patterning of materials is as old as the history of the laser. We have recently demonstrated a technique, Nonlinear Laser Lithography (NLL), that allows laser-controlled self-organized formation of metal-oxide nanostructures with nanometer levels of uniformity over indefinitely large areas by simply scanning the laser beam over the surface. We now seek to vastly improve these capabilities through advanced control of the laser field and spatially selective introduction of reactive chemical species with plasma jets.

Everything in Nature is self-organized. Natural systems generate structure and functionality effortlessly from stochastic processes, often shaped by nonlinear feedback mechanisms. Our approach is inspired by such processes, which are ubiquitous in Nature, but rare in man-made technology. Intense coherent electromagnetic waves produced by a laser is a great tool for control. Plasma jets allow precise and spatially localized introduction of desired reactive chemical specifies onto surfaces. By combining these two powerful leverages, we are focussed on extending our control over the self-organized dynamics to fabricate a plethora of 2D patterns of a wide range of material compositions, eventually assembled layer by layer into the third dimension.
The primary motivation for this work stems from a desire to understand how to effectively control self-organized processes involved in laser-material interactions. The broader context is that, we believe, by exploiting nonlinear mechanisms inherently present in many physical systems, we can achieve amazing technological functionalities, which are difficult or impossible to achieve in strictly linear systems. Besides this fundamental motivation, various practical applications can be envisioned, building on the capability of NLL to work on flexible, non-flat, and even rough surfaces, consequently, technical materials. This is an effort funded by the ERC Consolidator Grant "Nonlinear Laser Lithography".

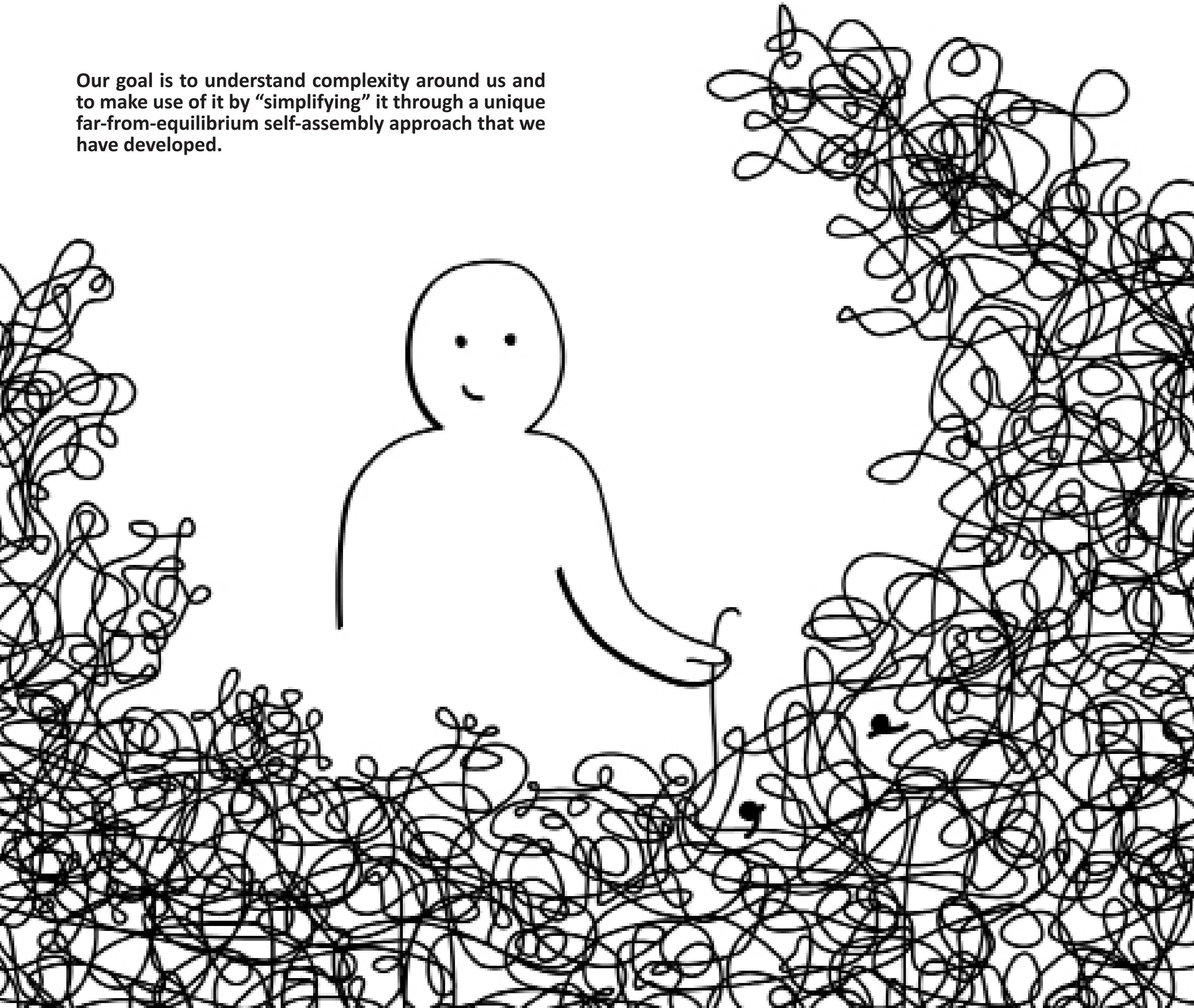
Other research undertaken by the Ultrafast Optics and Lasers Laboratory (UFOLAB) concerns development of novel mode-locked laser oscillators, high-power ultrafast fiber lasers and applications of the lasers we develop to biomedicine and advanced laser material processing.





"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."

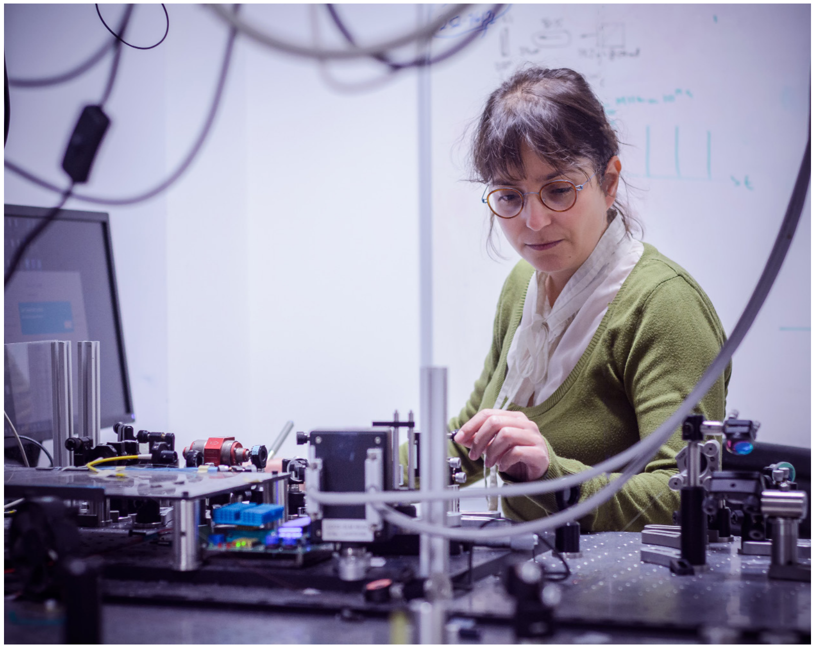
Our goal is to understand complexity around us and to make use of it by “simplifying” it through a unique far-from-equilibrium self-assembly approach that we have developed.



Dr. Serim Ilday

Simple Complexity

Self-assembly research has the potential to fulfill our ultimate technological and scientific desires that are (i) to mimic complex material architectures that we see in Nature to advance our technology (which performs adaptability and multifunctionality at multiple length scales), (ii) to understand emergence of life, and (iii) to decipher the universal rules that govern emergence of complex materials and behavior.



While it is universally recognized that human beings are complex systems, living a complex life in a complex environment, very little is known about how complexity emerges and how it can be controlled. Much of scientists' understanding of this matter comes from model systems such as cellular automata, which are so artificial that they have little relevance to actual physical systems. At the other end of the spectrum elaborate models designed to accurately represent real-life systems are so complicated that it is difficult to pinpoint the essential factors for the emergence of complex dynamics. Although there is no general theory for complex systems, this does not stop us from experimentally exploring controlled creation of complex structures and behavior, inspired especially by biological organisms.

The goal of Simply Complex Lab is to understand complexity around us and to make use of it by "simplifying" it through a unique far-from-equilibrium self-assembly approach that we have developed. We conduct interdisciplinary research at the interface between materials science, physics, chemistry and biology. Most recently, we have shown emergence of a unique, multi-scale and multi-functional complex hierarchical material and solved a 30 years old material challenge of fabricating connected-but-confined silicon quantum dot random network. Then, using the same physical principles in a different experimental platform we show emergence of very rich set of complex behaviors from simple polystyrene colloidal nanoparticles. They can form autocatalytic aggregates that can self-regulate, self-heal, self-replicate and migrate. Quite similar to living organisms, these aggregates can also take very many different forms (patterns); these forms then compete for limited resources, which often ends with the survival of the fittest and the "death" of less successful competitors.

Recently, we have focused our efforts towards establishing a "universal self-assembly" methodology that can be applied to almost any material, where the dynamics are largely independent of the initial conditions of the system, applied at the smallest scale as well as the largest. We showcase these efforts on a variety of materials ranging from microorganisms, to sub-10 nm particles, to ceramics and to metal surfaces. In doing so, we used very many different experimental setups ranging from vacuum systems to liquid/colloidal solutions to liquid crystals to light-solid interactions to light itself in the form of ultrashort laser pulses.

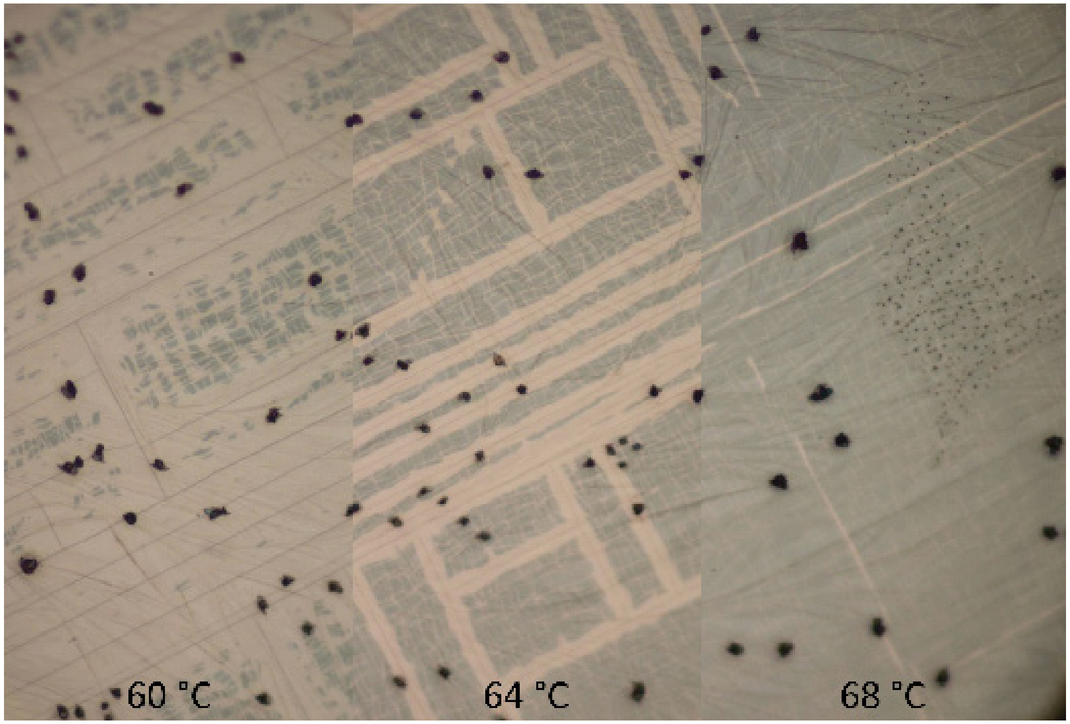
The outcomes of our research efforts are of interest to a variety of research fields and topics, namely, fundamentals of complex systems; far-from-equilibrium thermodynamics; soft condensed matter physics; emergent, exotic behavior of microorganisms under strong spatiotemporal gradients at very short time scales; soft robots of colloids and microorganisms; adaptive, multi-scale, multi-functional, complex materials for energy and mechanical applications; and dissipative chemistry. Our work has been published in prestigious journals including Nano Letters, Nature Communications, Nature Photonics, and recently highlighted in the media including Phys.org, MIT Tech News, Science Daily, IEEE Spectrum, Optics & Photonics News and Nanowerk.

"At SCMLab we investigate the fundamental properties of materials using optics and electronics to find new physics and applications"."

Dr. Serkan Kasırga

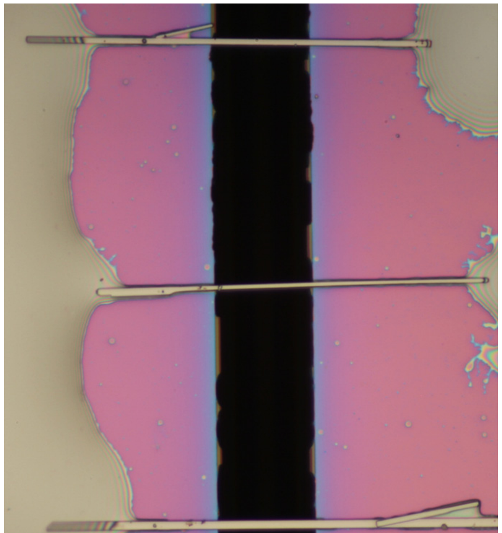
Strongly Correlated Materials

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.



Studying strongly correlations at nanoscales

When the interactions between electrons with other electrons and phonons in a material are comparable to the average kinetic energy of the electrons, single electron theories fail to capture the exotic phenomena observed. Metal-insulator transition, high Tc superconductivity and giant magnetoresistance are just a few examples of the phenomena emerging from the strong correlations. Part of our research is focused on understanding the phenomena emerging from the strong correlations in materials using experimental methods and applying this practical understanding to technologically useful applications. Our research is especially focused on the metal-insulator transition of vanadium dioxide. We study nano crystals of VO_2 using optics and electronics to achieve applications in electronics and hydrogen related applications.


30 nm thick nanobeams transferred across a 5 micron wide trench

2D Materials

Peculiar properties of graphene have attracted waves of attention and this interest has spread to other layered materials. The reason is mainly due to possibility of applications in wide range of areas using peculiar electronic, spin, orbital and valley interactions of 2D layered material heterostructures. Strain in such materials plays an important role in material parameters such as conductivity, mobility, band gap, magnetization, valley effects etc. Using standard optical and electronic probing techniques we study the effects of strain on the properties of layered materials and purpose made heterostructure devices.

Dr. Coşkun Kocabaş

Quantum Optoelectronics

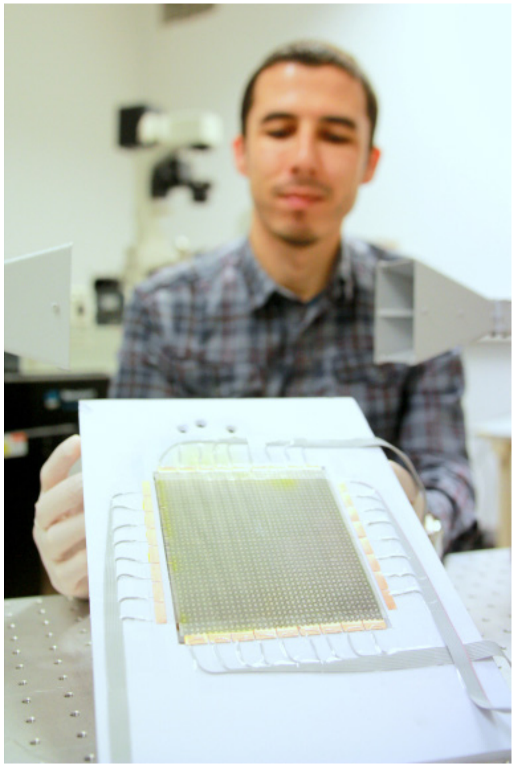
Our group is working on synthesis of new quantum materials and their integration in to electronic and photonic devices. Our long term goal is to understand and engineer electronic and optical responses of emerging quantum materials. Using these quantum materials we would like to develop multidisciplinary system-level approaches to build new integrated hybrid systems that yield novel functional devices. Our recent research is focused graphene based optoelectronic devices for tunable light-matter interaction in broad spectrum from visible to microwave frequencies.

Graphene-based adaptive camouflage

Radar-absorbing materials are used in stealth technologies for concealment of an object from radar detection. Resistive and/or magnetic composite materials are used to reduce the backscattered microwave signals. Inability to control electrical properties of these materials, however, hinders the realization of active camouflage systems. Our group is working on new approaches for adaptive camaoflage systems using large-area graphene electrodes. We developed active surfaces that enable electrical control of reflection, transmission and absorption of microwaves. Instead of tuning bulk material property, our strategy relies on electrostatic tuning of the charge density on an atomically thin electrode, which operates as a tunable metal in microwave frequencies. Notably, we report large-area adaptive radar-absorbing surfaces with tunable reflection suppression ratio up to 50 dB with operation voltages <5 V. Using the developed surfaces, we demonstrate various device architectures including pixelated and curved surfaces. Our results provide a significant step in realization of active camouflage systems in microwave frequencies.

Graphene based optoelectronics in the visible

Graphene emerges as a viable material for optoelectronics because of its broad optical response and gate-tunable properties. For practical applications, however, single layer graphene has performance limits due to its small optical absorption defined by fundamental constants. We are working on a new class of flexible electrochromic devices using multilayer graphene (MLG) which simultaneously offers all key requirements for practical applications; high-contrast optical modulation over a broad spectrum, good electrical conductivity and mechanical flexibility. Our method relies on electro-modulation of interband transition of MLG via intercalation of ions into the graphene layers. The electrical and optical characterizations reveal the key features of the intercalation process which yields broadband optical modulation up to 55 per cent in the visible and near-infrared. We illustrate the promises of the method by fabricating reflective/transmissive electrochromic devices and multi-pixel display devices. Simplicity of the device architecture and its compatibility with the roll-to-roll fabrication processes, would find wide range of applications including smart windows and display devices. We anticipate that this work will provide a significant step in realization of graphene based optoelectronics.



“Emerging quantum materials open up exciting possibilities for their fascinating optoelectronic properties.”

“We focus on the development of newly design 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.”

Dr. Bülend Ortaç

Laser Science and Technology

The scope of ORTAC Group research activities covers both the basic science and the various applications in fiber laser technology. This includes a wide-range from medical to industrial applications. We do study to go beyond the limits of original pulsed and CW laser sources in term of the compactness and power levels by utilizing a state-of-the-art fabrication technology in house. The ongoing re¬search 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.

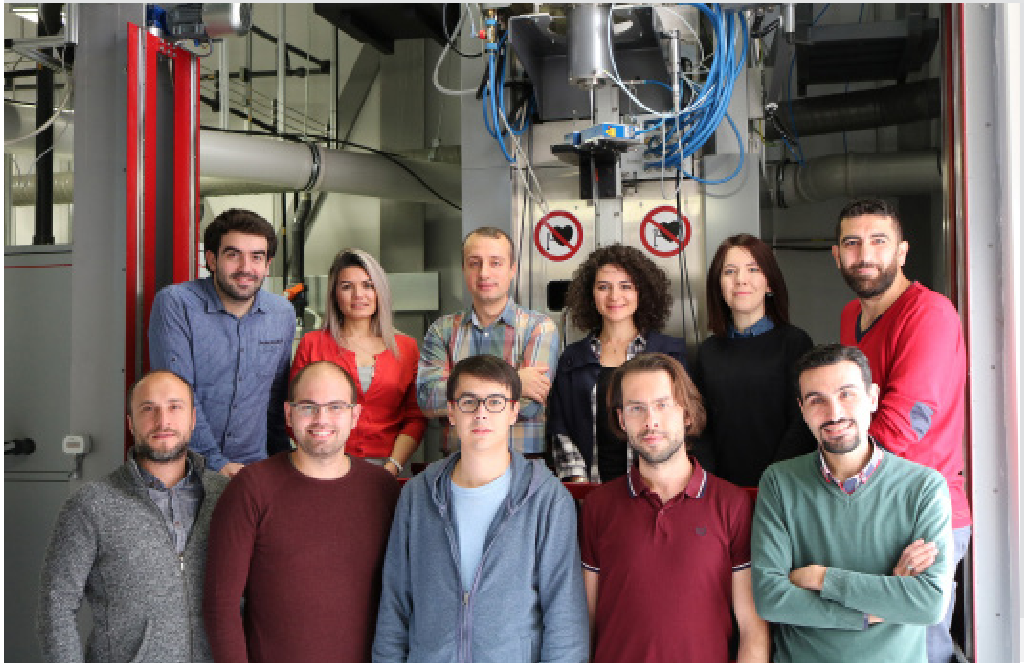
High-power fiber lasers are important and become popular in recent years due to their remarkable characteristics. In such fiber lasers, new generation of optic cables doped with active medium are used. In addition to the easy use in the field, capability of reaching at high powers of the new generation fibers are due to preventing local heat with relatively high absorption rates of the pump light all over the fiber. This allows us to obtain a high-quality optical cavity laser light produced during the use and optimization of the system.

We do focus on the new designs both in the fabrication process of the fibers and lasers yielding high-slope efficiency. This gives an opportunity to produce fiber lasers for different scientific and industrial applications including the defense industry. Furthermore, we also conduct theoretical studies to confirm and have a full control on the design parameters.

The quest on building of 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. We have also gained the skills on the fabrication of photonic crystal fibers that require generally the use of passive fibers via the drawing process at specific conditions. 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.

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.

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 develop¬ment to bio-medical applications.



"Human family trees are instrumental in solving the mysteries of the genome."

Dr. Tayfun Özçelik

Human Genetics and Genomics

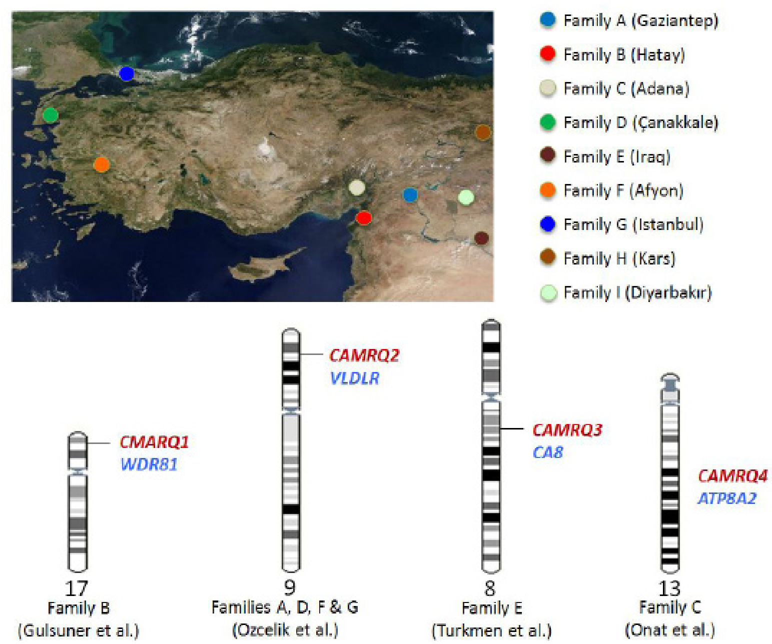
The focus of research in our laboratory is characterization of mutations and mechanisms that lead to genetic disorders in humans. Our journey into the genome began nearly 25 years ago by determining the chromosomal localization of cloned genes in human and mouse to identify the molecular basis of inherited 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).

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.

Quadrupedal gait

Genetic heterogeneity



Our research group is aiming at identifying novel targets overcoming resistance to state-of-art clinically-applied or -tested drugs and preventing metastatic spread of breast cancer. At molecular level, two major foci are proteins and non-coding RNAs, especially microRNAs in our lab.

Dr. Özgür Şahin

Systems Biology of Cancer

The major research themes in our lab are systems-level analysis of therapy resistance and metastasis mainly in breast cancer. Importantly, how epithelial-mesenchymal transition (EMT), which is an important initiator step in metastasis, contributes to drug resistance and how we can use this knowledge to better target cancer cells is another focus in our lab. Two most aggressive subtypes of breast cancer, HER2-overexpressing and triple negative breast cancers (TNBCs) as well as ER+ breast cancer are the major disease-foci. In addition to breast cancer, we work on the molecular pathogenesis of gastrointestinal stromal tumors (GISTs).

System Biology of Cancer

We focus on how mRNA/non-coding RNA networks contribute to drug resistance which ultimately leads to metastatic disease, and how we can use this knowledge to better target cancer cells. In addition, we aim to contribute to precision medicine by identifying novel biomarkers that can aid the choice of therapeutic regimen to be used in patients with different genetic background.

Enhancing chemotherapy response in triple negative breast cancer:

Triple-negative breast cancer (TNBC) is the most aggressive type of breast cancer. Chemotherapy is the mainstay therapy for TNBC patients; however, development of resistance is a major obstacle. In this line, we have developed in vivo chemoresistant models using both xenografts and tumor transplants from an established TNBC mouse model. Combining whole genome RNA and miRNA sequencing, bioinformatics and network biology, we are identifying novel miRNAs/lncRNAs/their target networks involved in chemoresistance, with an ultimate aim of enhancing chemo-response in TNBC. Overall, our interdisciplinary study provides pre-clinical data to enhance chemotherapy response in TNBC and identify biomarkers stratifying patients with higher response rate to chemotherapy.

Overcoming endocrine resistance in ER-positive breast cancer:

More than 70% of breast tumors express estrogen receptor alpha (ER-alpha), which makes them ideal candidates for ER-targeting therapies. Tamoxifen has been the mainstay hormonal therapy for ER-positive breast cancer patients; however, development of resistance is a major obstacle in clinics. Considering the high incidence rate of ER-positive breast cancer with 1.2 million new cases diagnosed each year worldwide, and the significant number of cases developing drug resistance, there is an urgent need for identification of novel drug targets to overcome tamoxifen resistance. In the respect, we aim to identify novel mechanisms of tamoxifen resistance and thus pave the way for testing new combinations to improve survival in tamoxifen refractory, ER-positive breast cancer.

Novel approaches for overcoming therapeutic resistance in HER2-positive breast cancer:

Trastuzumab emtansine (T-DM1, Kadcyla®) is a next generation HER2-ADC, combining trastuzumab, along with its cytostatic functions, with a potent microtubule targeting agent, DM1 (derivative of maytansine 1) via a stable linker, MCC. Based on its favorable efficacy results, T-DM1 was swiftly approved by FDA in 2013. Even though it offers a huge clinical benefit for previously treated HER2-positive breast cancer patients, a substantial number of patients eventually progress and frequently develop acquired resistance. In this context, we have implemented a combinatorial approach involving the high-throughput transcriptomics (e.g. RNA-Seq)/proteomics (e.g. RPPAs), bioinformatics/modeling tools and drug design, aiming at identifying novel targets to overcome resistance and prevent metastatic spread, by using state-of-art clinically-tested drugs or newly designed drug molecules with better efficiency.

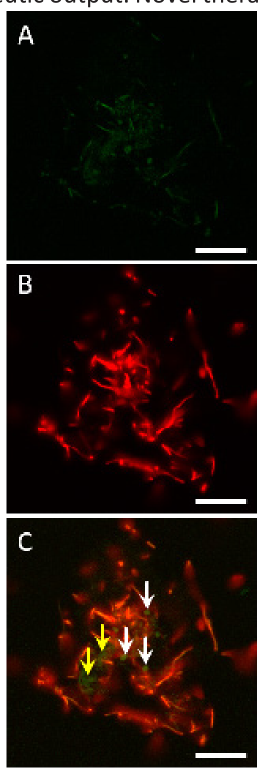
Dr. Urartu Özgür Şafak Şeker

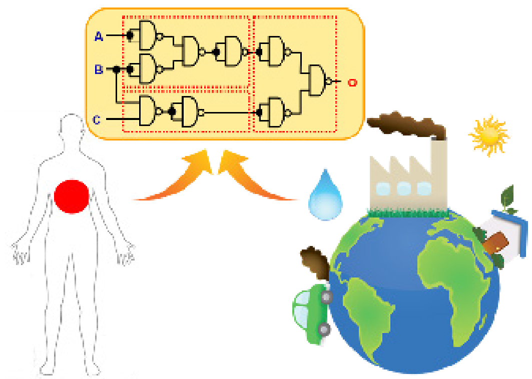
Synthetic Biosystems

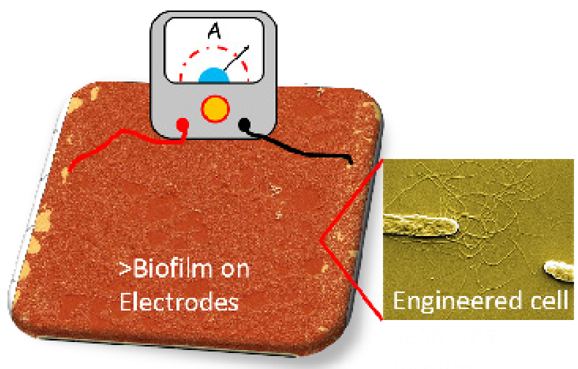
Synthetic Biology is an emerging engineering discipline which focuses on designing and implementation genetic devices inspired by electrical engineering and computer science. We are interested in designing and implementation of genetic circuits: to build whole cell sensors, to create novel biocatalysis systems, and to produce nano/biomaterials with engineered functionality. We are also interested in designing and utilization synthetic genetic regulation systems and elements.

Synthetic biology is changing our view for designing of new organisms with synthetic gene expression and its synthetic regulations for a desired functionality. Synthetic biology is aiming to engineer both native metabolic pathways and exploring novel pathways in an organism for advanced well controlled functionality. Systems biology catalogs novel parts, metabolic networks, and regulatory strategies from various organisms these are being exploited by synthetic biology. In synthetic biology applications each functional genetic part was considered as a component in a circuit. Synthetic circuits are formed using genes/proteins and genetic regulation elements. To form a genetic circuit well characterized biological parts from various organism can be exploited. Some of these parts are nucleic acids, genetic regulatory elements and proteins. Combining these biological parts logic gates, memory units, biological switches (e.g. toggle switches), biological oscillator, biological devices those can make computations can be formed. A genetic language to program cellular functions can be achieved as well. All the biological devices under the control of a cellular program can achieve highly complicated tasks for a certain function.

Research in our lab investigates broad range of possible applications of synthetic biology ranging from diagnosis to 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 certain inputs are studied. In coordination with biosensor studies, theranostic applications are broadly explored since genetic circuitry in whole cell biosensors can be designed for generating therapeutic output. Novel theranostic solutions for diabetes, neurodegenerative disorders, viral infections and cancer are probed. Targeted therapy is the most important highlight in solutions for cancer and viral infection. Additionally, limits of functional biomaterial production and development are broadened using enhanced biological processes such as biofilm formation and biomineralization. In order to achieve aims of our group, novel techniques and approaches for synthetic biology are perfected such as optogenetic and logic elements. Also, novel synthetic biology techniques for disease research are developed for a better understanding of the underlying mechanisms. For all these purposes, we use organisms such as Escherichia coli, yeast strains, mammalian cell lines, and zebrafish in our lab.







“Synthetic Biosystems Laboratory has sucessfull showed to develop new materials using biofilm proteins by employing synthetic genetic circuits. In its diverse research interest SBL is currently developing whole cell sensors to monitor nanomaterial biocompatibility, and to carry biomedical tests to monitor disease conditions”

Dr. Dönüş Tuncel

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.

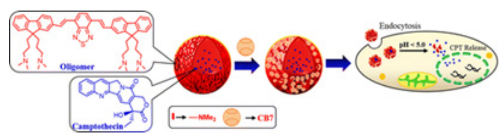
Light emitting functional conjugated polymers and nanostructures:

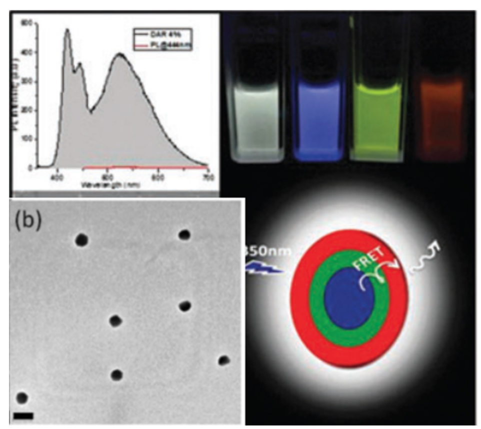
We design and synthesise a number of different useful functional groups containing conjugated polymers and oligomers and exploit their applications in the areas of optoelectronics and photonics as well as nanomedicine.

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.

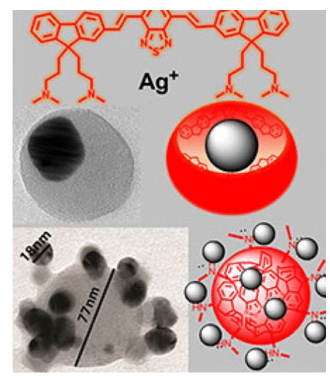




Construction of multi-layered white emitting organic nanoparticles by clicking polymers, Journal of Materials Chemistry, 2015, 3, 10277-10284

Hybrid organic-inorganic nanostructures:

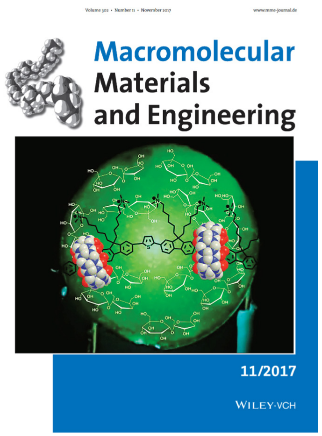
We combine intrinsically fluorescent conjugated oligomers/polymers with Au or Ag nanoparticles in one platform to be used as a multimodal therapeutic nanocarrier in which due to gold, photothermal therapy and the conjugated oligomer/polymer matrix photodynamic therapy would be possible. Moreover, nanoparticles 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.

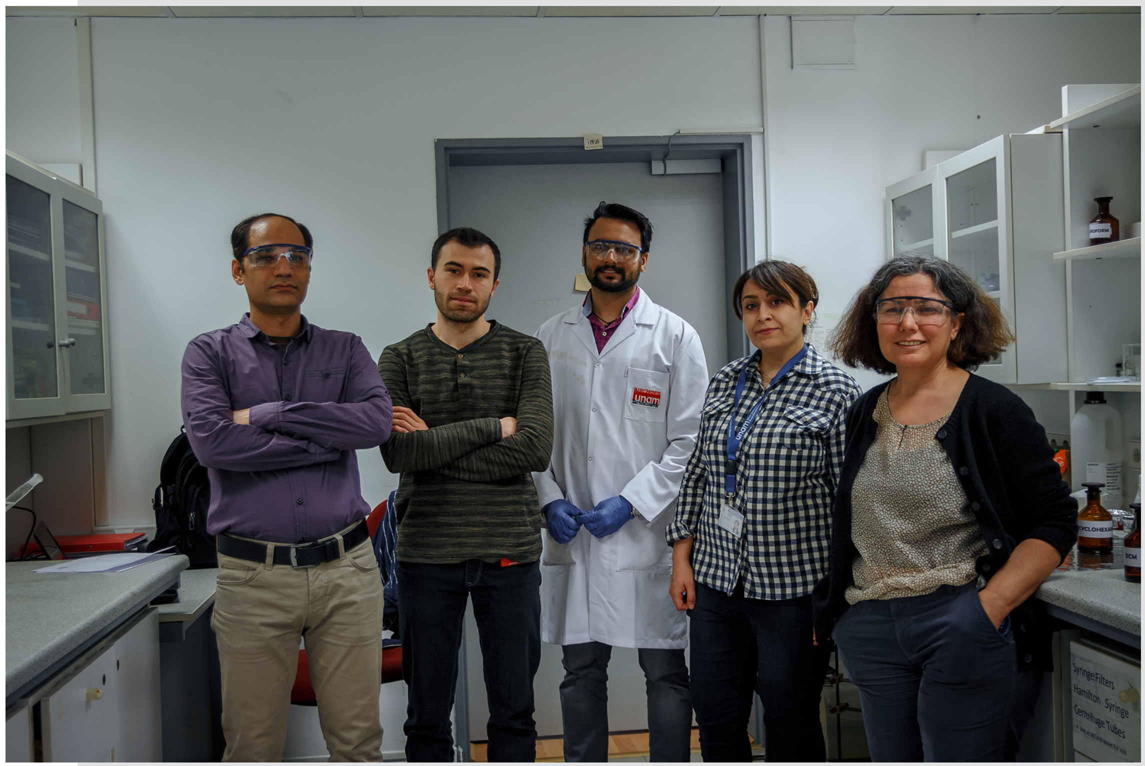


One Pot Synthesis of Hybrid Conjugated Oligomer-Ag Nanoparticles, ACS Omega, 2017, 5470–5477

Photoactive conjugated polyrotaxanes/ Molecular switches:

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



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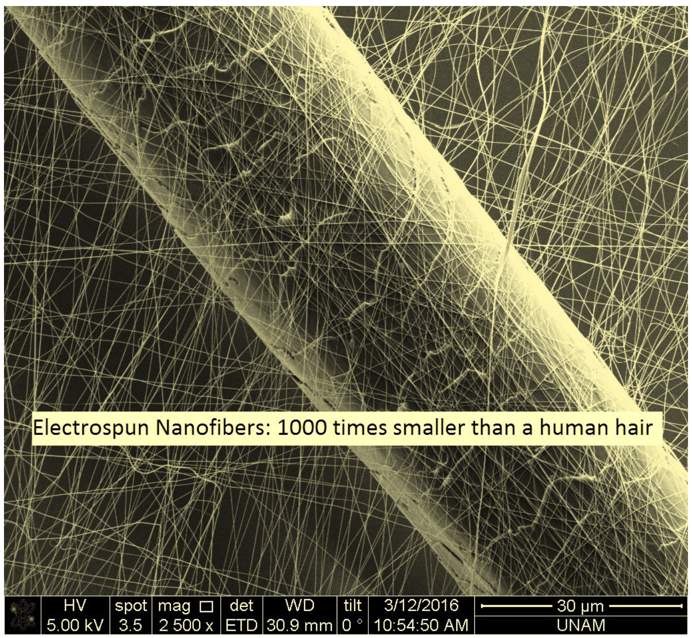
Dr. Tamer Uyar

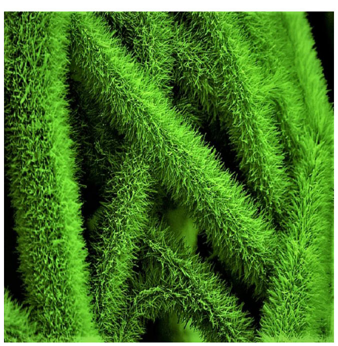
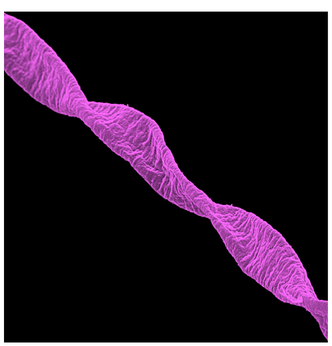
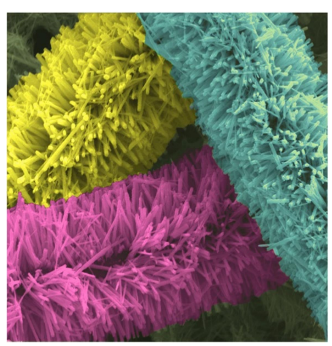
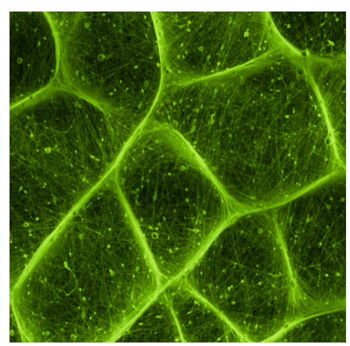
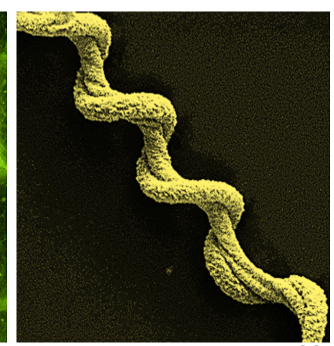
Functional Nanofibers and Fibrous Nanomaterials

Uyar Research Group have a main focus on electrospinning of nanofibers/nanowebs and fibrous nanomaterials with novel functionalities for potential applications in Environmental/Filtration (molecular filters, water purification, waste treatment, heavy metals removal, air filtration, VOCs removal), Health Care (drug controlled/sustained release systems, wound dressing, biomedical applications, tissue engineering), Food and Food Packaging (delivery and stabilization of food additives; essential oils, antioxidants, antibacterials, nanofood), Catalysis (photocatalysis for water treatment, flexible nanofibrous heterogeneous catalysts systems), Sensors (heavy metal sensors, explosive sensors, biosensors), Energy (water splitting, Li-ion batteries, solar cells), Textiles (antibacterial medical textiles, protective textiles), Agriculture (nanofertilizer, seed/plant protection, controlled delivery of pesticides) and Nanocomposites (high performance nanofibrous nanocomposites).



In 2017, Our research studies can be summurized in the following sub-topics;
- Functional Nanofibrous Webs for Water Remediation
- Functional Nanofibers as Flexible and Reusable Heterogeneous Nanocatalysts
- Functional Nanofibers for Drug Delivery, Wound Dressing and Tissue Engineering
- Functional Nanofibrous Webs for Food and Food Packaging Applications
- Fluorescent and Flexible Polymeric Nanofibrous Materials for Sensing

In 2017, Uyar Research Group has published 35 journal papers and some of these papers are publsihed in high impact journals in the related research field including Advanced Materials Interfaces (Cover article), Materials Today (Cover), Scientific Reports (2), ACS Applied Mat.&Interfaces, Nanoscale, J Materials Chemistry (A,B,C), J Agricultural&Food Chem., Food Chemistry (2), Chem Eng J, Int. J. Pharmaceutics, Catalysis Sci.&Tech., App. Cat. B:Environmental. Prof. Uyar has edited a new book “Electrospun materials for tissue engineering and biomedical applications: research, design and commercialization” (edited by Tamer Uyar and Erich Kny), Elsevier, Woodhead Publishing, 2 June 2017, UK (ISBN: 9780081010228). Uyar Group has also contributed 4 book chapters in 2017. Since February 2017, Prof. Uyar became a new *Editorial Board Member for Scientific Reports*, a journal published by Nature Publishing Group.

Dr. Giovanni Volpe

Soft Matter, Optical Tweezers and Complex Systems

Our research focuses are primarily on statistical physics, soft matter, optical manipulation, and stochastic phenomena. We are interested in both experimental and theoretical aspects. We have also been active in plasmonics, Raman spectroscopy, biophotonics, cylindrical vector beams, and fiber optics.

Nanoscience and nanotechnology are in the process of revolutionizing the way we live and do science. Micro- and nanodevices herald a new era with unprecedented possibilities in sensing and information processing at the nanoscale. Perhaps more importantly, with the development of nanotechnology comes the hope of greatly reducing the need for prime materials and manufacturing, thus leading to a much cleaner post-industrial society. In the context of this drive towards the nanoscale, the specific aim of the soft matter lab is to harness nanoscopic forces and active matter at mesoscopic and nanoscopic length-scales in order to gain a better understanding of their fundamental properties and to explore high-impact applications.

Optical tweezers

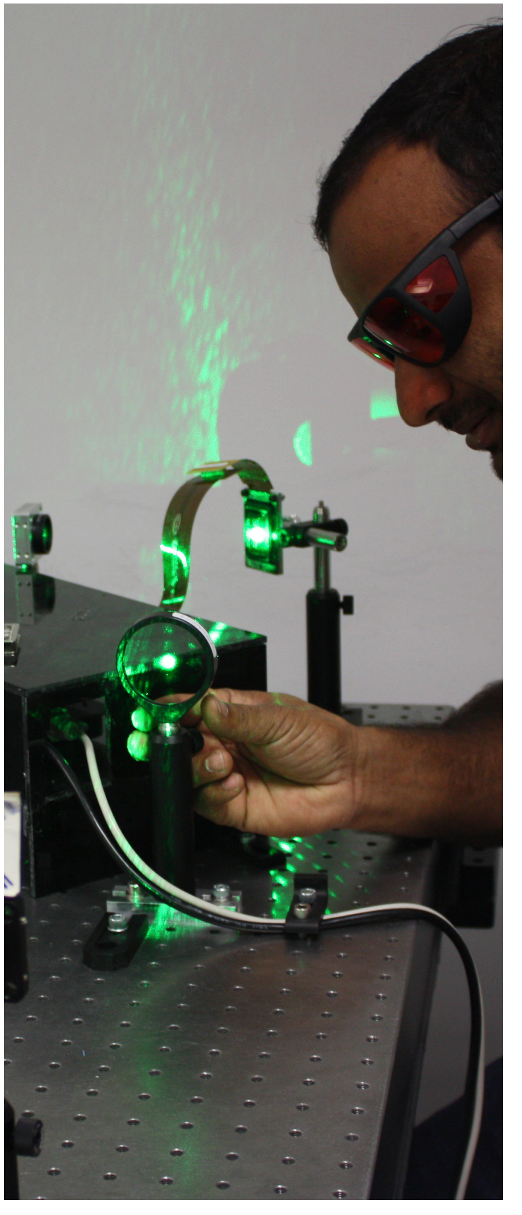
An optical tweezers is generated by a highly-focused laser beam and is capable of trapping and manipulating microscopic particles, such as cells, organelles and molecules. We are developing the optical tweezers technique so that it can explore new ranges of applications towards the nanoscale.

Measurement of nanoscopic forces

The ineluctable presence of thermal noise alters the measurement of forces acting on microscopic and nanoscopic objects, such as biomolecules and nanodevices. Our results demonstrate that the force-measurement process is prone to artifacts if the noise is not correctly taken into account. Our results are intimately connected to the long-standing issue of the interpretation of multiplicative noise in stochastic differential equations.

Active matter

Differently from passive Brownian particles, active Brownian particles, also known as microswimmers, are capable of driving themselves out of equilibrium by taking up energy from their environment and converting it into directed motion. Therefore, understanding their motion can provide insight into out-of-equilibrium phenomena associated both to biological entities such as bacteria and to artificial microswimmers. We have develop several kinds of novel microswimmers and we are employing them to explore new applications in the localization, pick-up and delivery of microscopic cargoes for, e.g., biomedical applications.



“The intersection of statistical physics, soft matter and optical manipulation creates us opportunities in a variety of applications.”

UNAM PATENTS

Patent Number	Title	Place	Date	Status
US2016141542 (A1)	Organic Light Emitting Device	US	2016	Patent Pending
US20160091509 (A1)	Cartridge device with segmented fluidics for assaying coagulation in fluid samples	US	2016	Patent Pending
2015/11116 PCT/TR2016/000112	Blood Coagulation Time Measurement Method and Apparatus	Republic of Turkey Patent Institute, US	2015	Patent Pending
2015/15179 2015/15188 2015/15196	An Inductive Coil Unit	Republic of Turkey Patent Institute	2015	Patent Pending
2015/09779 USPTO1495300	Material System with Sub-Micrometer-Scale Interfaces Exhibiting Structural Lubricity Under Ambient Conditions and the Method for Synthesis Thereof	Republic of Turkey Patent Institute, US	2015	Patent Pending
TR 2015/04...	Spontaneous High Piezoelectricity in Poly(vinylidene fluoride) Nanowires Produced by Iterative Thermal Size Reduction Technique	Republic of Turkey Patent Institute	2015	patent pending
TR 2015/04...	Motion- and Sound-Activated, 3D-Printed, Chalcogenide-Based Triboelectric Nanogenerator	Republic of Turkey Patent Institute	2015	patent pending
TR 2014/0413	Glycopeptide Nanostructures for Cartilage Regeneration	Republic of Turkey Patent Institute	2014	patent pending
WO2014TR00083 14/774,138 EP2972442 KR20150144749 TR20130003085	Enhancement of Magnetic Resonance Image Resolution by Using Bio-compatible, Passive Resonator Hardware	Republic of Turkey Patent Institute,US,EU,Korea,	2014	issued
G-16885	Heparin Mimetic Peptide Nanofibers for Growth Factor Binding	Republic of Turkey Patent Institute	2011	issued
G-149978	Plasmon Integrated Sensing Mechanism	Republic of Turkey Patent Institute	2011	issued & commercialized
US 2012122668 EP 2294014 JP 2011519720 CN 102164860	A photocatalytic nanocomposite material	USA, EU, Japan, China	2011, 2012	issued
US2011152725 (A1) KR20110044758 (A) JP2012501237 (A)	Biomems Sensor and Apparatuses and Methods Thereof	US; Korea, Japan	2009	issued

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UNAM PRIZES & AWARDS

TÜBİTAK Science Award

Prof. Ömer İlday of the Departments of Electrical and Electronics Engineering and Physics and UNAM has been recognized by The Scientific and Technical Research Council of Turkey (TÜBİTAK) for 2017.

Prof. İlday is the winner of the prestigious TÜBİTAK Science Award of 2017 in the field of Basic Sciences. The Science Award is the highest scientific award given by TÜBİTAK every year.

Academy of Pharmacy Award

Prof. Engin Umut Akkaya of the Department of Chemistry and UNAM has received the Turkish Association of Pharmacists (TEB) Academy of Pharmacy's highest award, given to recognize "eminently distinguished achievement." This is the first time the Academy has presented this award to a chemist.

Prof. Akkaya's work in radically transforming the photodynamic therapy (PDT) of cancer has received worldwide attention and been featured on the covers of leading scientific journals. Photodynamic therapy has been a promising modality for treating cancer; however, for optimal efficiency, the tumor tissues being targeted must have normal oxygen levels, and the light used for excitation must be able to reach the tumor region. These two issues have generated formidable problems, limiting the practicability of the methodology. The research done in the Akkaya lab is expected to extend the applicability of the treatment to deep-seated and hypoxic tumors.

Bilkent University's 7th ERC Grant

Asst. Prof. Selim Hanay of the Department of Mechanical Engineering and UNAM has been awarded a European Research Council (ERC) Starting Grant. Dr. Hanay will be using the grant's 1.5 million Euro funding for his research project "Resonant Electromagnetic Microscopy: Imaging Cells Electronically."

With this funding, a radar-like device capable of detecting diseased cells will be developed at Bilkent University and UNAM. Dr. Hanay and his research team are planning to bring together a variety of different disciplines and techniques, such as nanomechanics, microfluidics and microwave sensors, to produce this novel instrument. The ultimate goal of the project is to develop a portable, low-cost and fast electronic instrument for the early detection of disease.

ERC grants are widely considered to be the most prestigious individual support provided by the European Union; a number of Nobel laureates have been among the recipients of ERC funding. The competition for ERC support, which is open to researchers of all nationalities working in a host institution in an EU member state or associated country, is keen. Dr. Hanay's grant is the seventh ERC grant to have been received by Bilkent University and UNAM researchers since the start of the ERC funding program in 2007; to date, 15 researchers from Turkey have benefited from this support.

MÜSİAD's Science and Technology Award

UNAM is awarded with Independent Industrialists' and Businessmen's Association's (MÜSİAD) Science and Technology Award for its contribution in the advancement of the National Science and Technology in Turkey. MÜSİAD is a non-govermental businessmen's association founded on May 5, 1990, in Istanbul. Asst. Prof. Serkan Kasırga, Assistant Director of UNAM, attended the award ceremony to receive the Award.

Eczacıbaşı Medical Incentive Award

At a ceremony held at Dokuz Eylül University in İzmir on Friday, October 13, Asst. Prof. Özgür Şahin of the Department of Molecular Biology and Genetics and UNAM was presented with an Eczacıbaşı Scientific Research and Medical Incentive Award.

The Dr. Nejat F. Eczacıbaşı Awards are given annually by the Eczacıbaşı Group, the parent company of Turkey's leading pharmaceuticals manufacturer in remembrance of the group's founder. The Eczacıbaşı Scientific Research and Medical Award Fund was established by Dr. Eczacıbaşı to promote the development of Turkey's health sciences; the jury for the first award, presented in 1959, included several legendary figures of Turkish medicine. Dr. Şahin received the award for his contributions to cutting-edge research at the international level in the field of cancer biology.

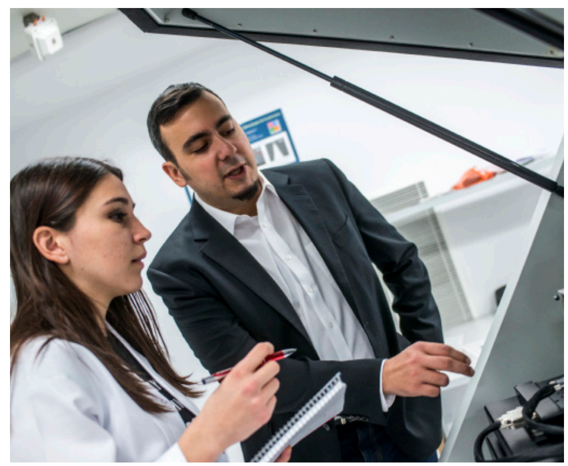
TÜSEB Aziz Sancar Awards

At a ceremony held in İstanbul, Prof. Engin Umut Akkaya of the Department of Chemistry and UNAM and Asst. Prof. Özgür Şahin of the Department of Molecular Biology and Genetics and UNAM were presented with awards by TÜSEB The Health Institutes of Turkey. Named after Nobel laureate Aziz Sancar, the TÜSEB awards honor outstanding work by the country's researchers in fields related to the health sciences.

Prof. Akkaya received the Aziz Sancar Science Award, TÜSEB's highest accolade. The Science Award, given for the first time this year, is to be presented annually to a scientist who has made internationally significant contributions to the advancement of the health sciences and technologies. Prof. Akkaya received the award for his research in radically transforming the photodynamic therapy of cancer.

Dr. Şahin was the recipient of a TÜSEB Aziz Sancar Incentive Award. These awards are given to a maximum of five recipients each year: scientists under the age of 40 who have proven their potential to contribute to science at an international level. Dr. Şahin received his award for his cutting-edge research in the field of cancer biology.

Gerhard Ertl Young Investigator Award



Asst. Prof. Mehmet Z. Baykara of the Department of Mechanical Engineering and UNAM has been selected as one of the top five finalists of the 2017 Gerhard Ertl Young Investigator Award of the German Physical Society-Deutsche Physikalische Gesellschaft, DPG.

This prestigious early-career award recognizes a young researcher for his/her outstanding research in surface science. The award is named after Nobel Laurate Gerhard Ertl, who received the 2007 Nobel Prize in Chemistry for his contributions to the field of surface science. The winner of the award will be determined at a special session held during the 2017 Spring Meeting of DPG, where each finalist will be asked to deliver an oral presentation about their latest research accomplishments.

UNAM PUBLICATIONS & ACHIEVEMENTS

PUBLICATIONS

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UNAM research groups have pioneered the development of novel methods and techniques, which were published in highly respected, international refereed journals. In 2017, UNAM reserchers published 139 journal articles.

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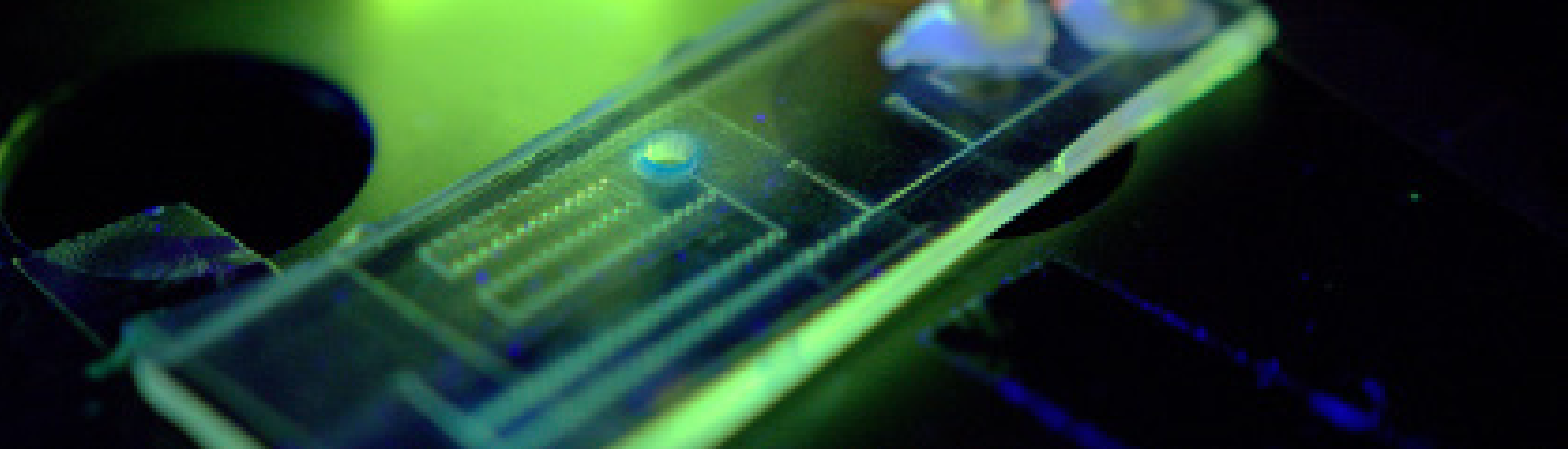

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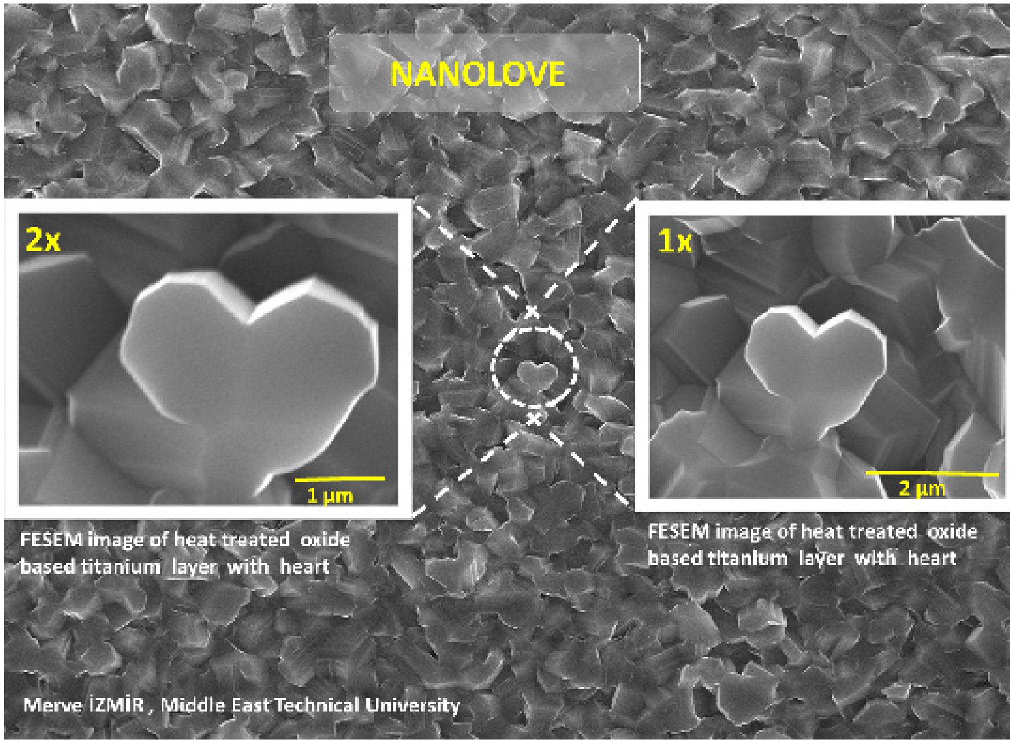

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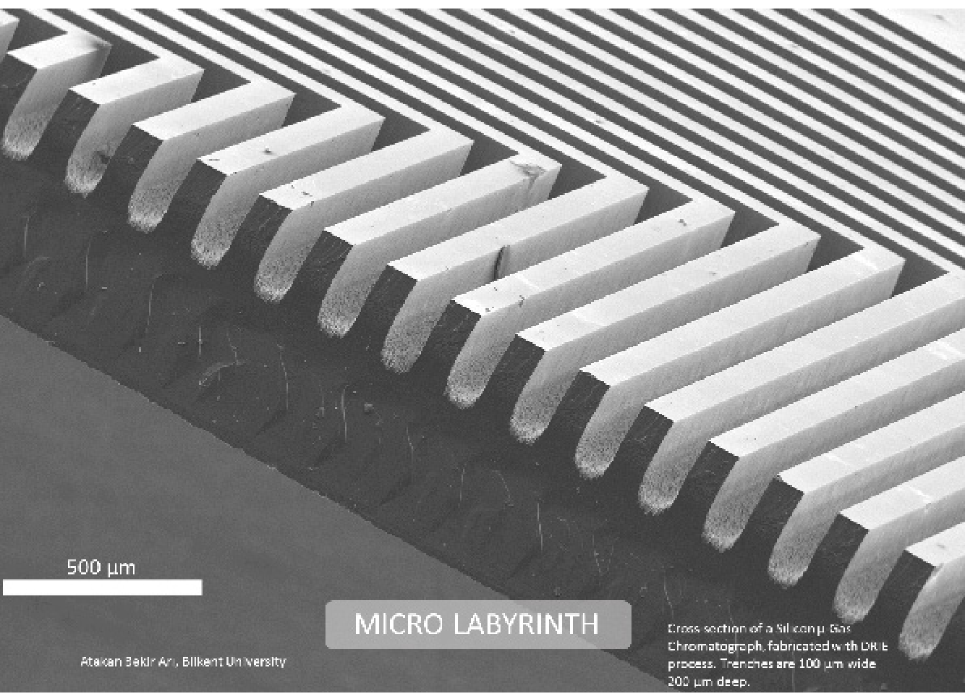

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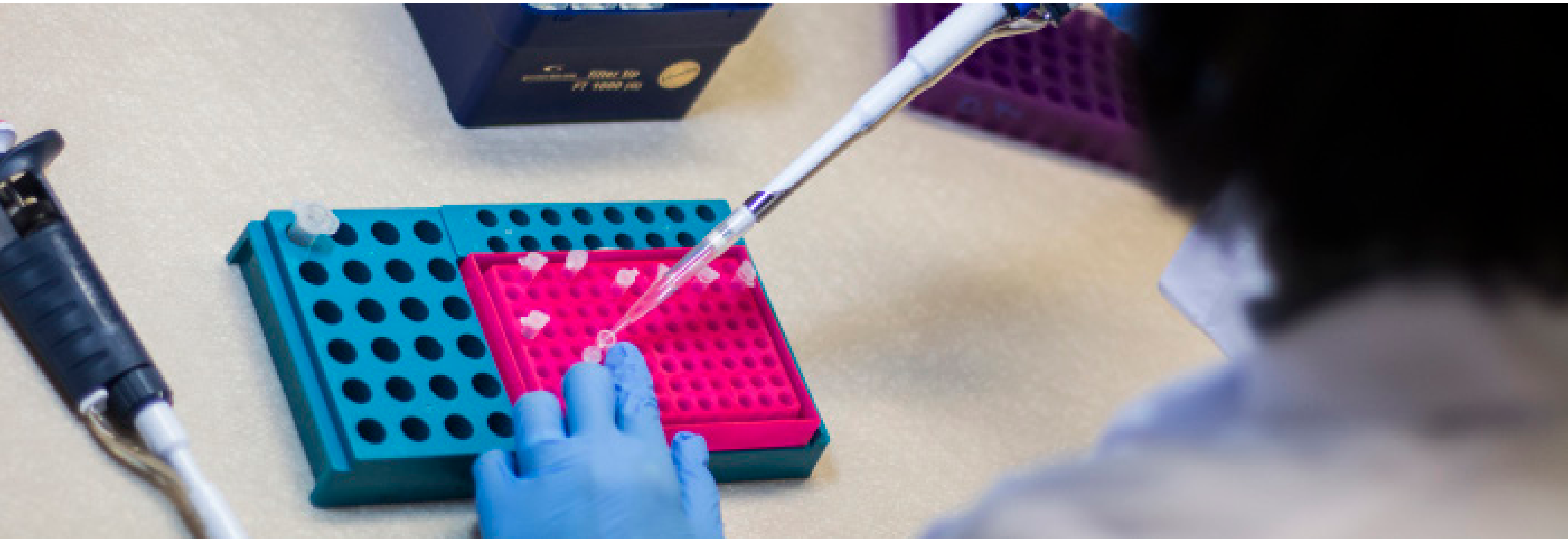

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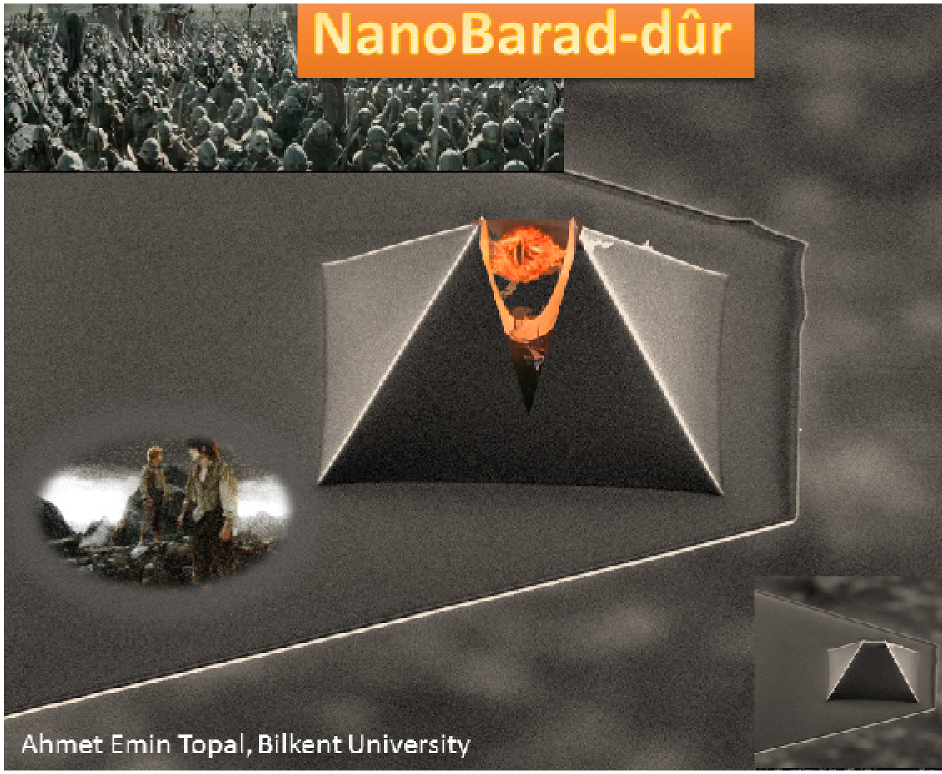
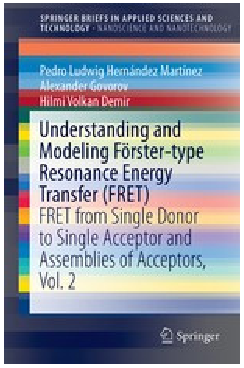
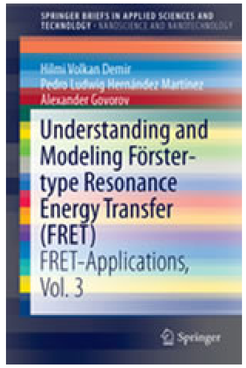


Textbooks published by UNAM faculty members in 2017



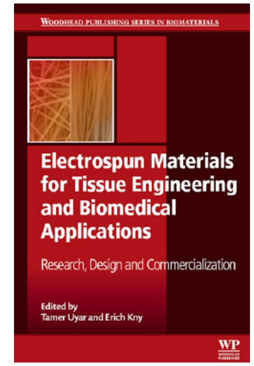


Professor Hilmi Volkan Demir, Electrical and Electronics Engineering and Physics Departments and UNAM, co-authored and edited a book for Springer Briefs Series in Nanoscience and Nanotechnology. The book is entitled “Understanding and Modeling Förster-type Resonance Energy Transfer (FRET)”.

The first book of the “Understanding and Modeling Förster-type Resonance Energy Transfer (FRET)” series was published in 2016 and the second and the third books are published in 2017.

The second book “FRET from Single Donor to Single Acceptor and Assemblies of Acceptor, Vol.2” presents a complete study of the generalized theory of Förster-type energy transfer in nanostructures with mixed dimensionality. In this volume, aim is to present a generalized theory of FRET including a comprehensive set of analytical equations for all combinations and configurations of nanostructures and deriving generic expressions for the dimensionality involved. In this brief, the modification of FRET mechanism with respect to the nanostructure serving as the donor vs. the acceptor is included, focusing on the rate’s distance dependency and the role of the effective dielectric function in FRET, which is a unique, useful source for those who study and model FRET.

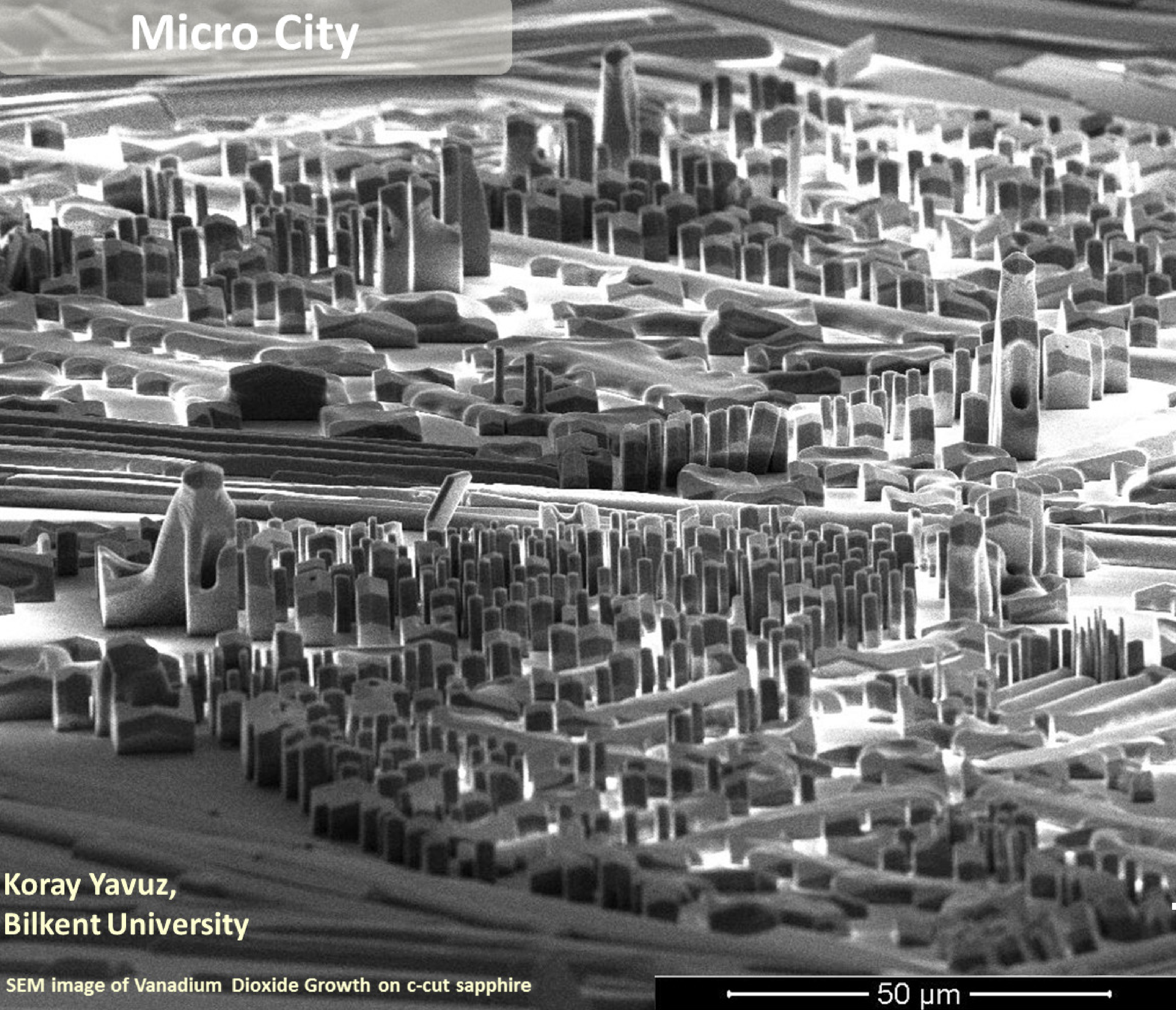
The third book “FRET-Applications, Vol. 3” focuses on the functional uses and applications of FRET, starting with the derivation of FRET in the assemblies of nanostructures and subsequently giving application cases for biologists, physicists, chemists, material scientists, engineers, and those in many other fields whoever would like to FRET as a tool. The goal of this volume is therefore to show both specialist and non-specialist how to use and analyze FRET in a wide range of applications.



Assoc. Prof. Tamer Uyar, MSN and UNAM, is the editor of a new book “Electrospun materials for tissue engineering and biomedical applications: research, design and commercialization”.

Electrospinning, an electro-hydrodynamic process, is a versatile and promising platform technology for the production of nanofibrous materials for tissue engineering and biomedical applications. Electrospun Materials for Tissue Engineering and Biomedical Applications examines the rapid development of electrospun materials for use in tissue engineering and biomedical applications. With a strong focus on fundamental materials science and engineering, this book also looks at successful technology transfers to the biomedical industry, highlighting biomedical products already on the market as well as the requirements to successfully commercialize electrospun materials for potential use in tissue engineering and biomedical areas. This book is a valuable resource for materials and biomedical scientists and engineers wishing to broaden their knowledge on the tissue engineering and biomedical applications of electrospun fibrous materials.

The editors of this book are Tamer Uyar and Erich Kny, and the book is published by Elsevier, Woodhead Publishing Series in Biomaterials (ISBN: 9780081010228).


Micro City
Koray Yavuz,
Bilkent University
SEM image of Vanadium Dioxide Growth on c-cut sapphire
50 µm

UNAM NANODAY 2017

UNAM ogranized the 4th NanoDay event on 25 May 2017. UNAM is hosting NanoDay events annually and each year world renowned scientists are invited to this one-day event.

UNAM's seminar series have closed for the semester with a full-day event, Nanoday 2017, featuring a NanoArt Contest and poster presentations as well as keynote talks by three world-renowned researchers. Prof. Andrey Rogach (City University of Hong Kong), Prof. Ernst Meyer (University of Basel) and Prof. Hendrik Heinz (University of Colorado) were the speakers for the annual event. The NanoDay event carried special meaning this year, as the 10th Anniversary of UNAM was celebrated.

2017 NanoArt Contest Winner by Efe Musa Isilak

Opening speech by Prof. Abdullah Atalar, Rector of Bilkent University, at NanoDay 2017

Prof. Hendrik Heinz, 2016 Fellow of the Royal Society of Chemistry (UK), presenting his latest research on the discovery of new materials by simulation and experiment.

Participitants discussing and receiving information about the latest products by Nanoday sponsors.

NanoDay talks were followed by an awards ceremony for the winners of the Best Poster award and NanoArt contest. Musa Efe Isilak, Koray Yavuz and Bartu Simsek won the NanoArt Contest, while Gokhan Gunay, Tolga Tarkan Olmez and Ranjit Shanmugam received the best poster award.

UNAM OUTREACH

Bilkent University Nanoscience Society's Activities at UNAM

Bilkent University Nanoscience Society is an active student club whose board members are the UNAM Student Ambassadors.

MSN Graduate Seminars are among the most important activities of Nanoscience Society that took place in the last academic year. These seminars aim at allowing the graduate speakers to gain experience in presentation skills and to introduce his/her studies to a larger community. As part of the seminars, Ph.D. candidates in MSN graduate program and other departments as well as post-doctoral researchers delivered presentations. In addition to these seminars, two different series of activities have been put into practice. The first of them is the non-technical and culturally enriching talk series named "UNAM*talks*". In the last academic year, two prestigious scientists, Prof. Orhan Guvenen ve Prof. Niyazi Serdar Sarıciftci, were hosted in UNAM*talks* and each event attracted very high participation. As part of these series, UNAM continues to host reputable names from both academia and industry. The second of the activities is a workshop series named "UNAM*workshops*". The aim of these workshops is to bring together fellow researchers having expertise in a frequently used software platform with students. In 2017, workshops on MATLAB, SolidWorks, and LEdit were organized. Additionally, Bilkent University TTO Director Dr. Atilla Hakan Özdemir gave a presentation on academic entrepreneurship as a workshop. Finally, an outreach stand was opened and the institute was advertised in several career fairs and conferences.

Nanocolloquium Series at UNAM

UNAM hosts Nanocolloquia on advancements in nanoscience and nanotechnology. These invited lectures bring us the most recent developments in the exciting fields of nanoscience and nanotechnology.

SPRING 17

02.24 / Prof. Kenneth Dawson
03.10 / Prof. Ruben Perez
03.24 / Prof. Sijbren Otto
04.28 / Prof. Cagatay Başdoğan

FALL 17

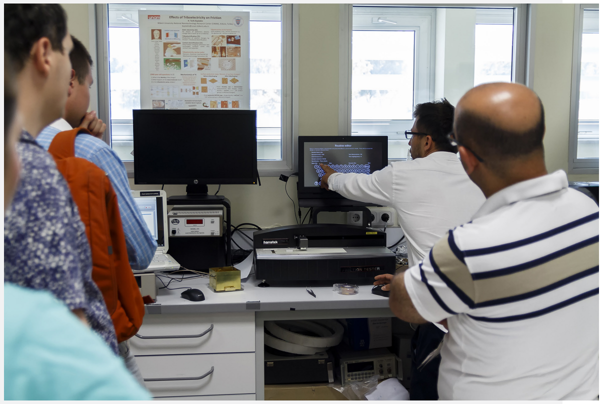
10.06 / Asst. Prof. Ramez Danial
10.13 / Prof. Guido H. Clever
10.27 / Prof. Gonen Ashkenasy
11.10 / Assoc. Prof. Rienk Eelkema
11.17 / Assoc. Prof. Seda Keskin Avcı
11.24 / Prof. Ludovic Jullien
12.08 / Asst. Prof. Selim Hanay
12.15 / Prof. Roman Jerala

IWANN 2017 at UNAM

International Workshop on Applications of Nanoscience and Nanotechnology

Every year UNAM organizes an International Workshop on Applications of Nanoscience and Nanotechnology funded by the Ministry of Science, Industry and Technology and supported by UNIDO and TIKA. This year's theme was Energy for Future. Through a 10-day workshop, participants joined the lectures by the frontiers of the field including Prof. Niyazi Serdar Sarıçiftçi of Johannes Keppler University and attended hands-on training to increase their practical knowledge.

30 scientists from 13 different countries have attended the seventh IWANN workshop. During their stay, participants enjoyed social activities and joined cultural activities. The event contributed to formation of a scientific network among the participants.



Bilkent UNAMBG Synthetic Biology Day

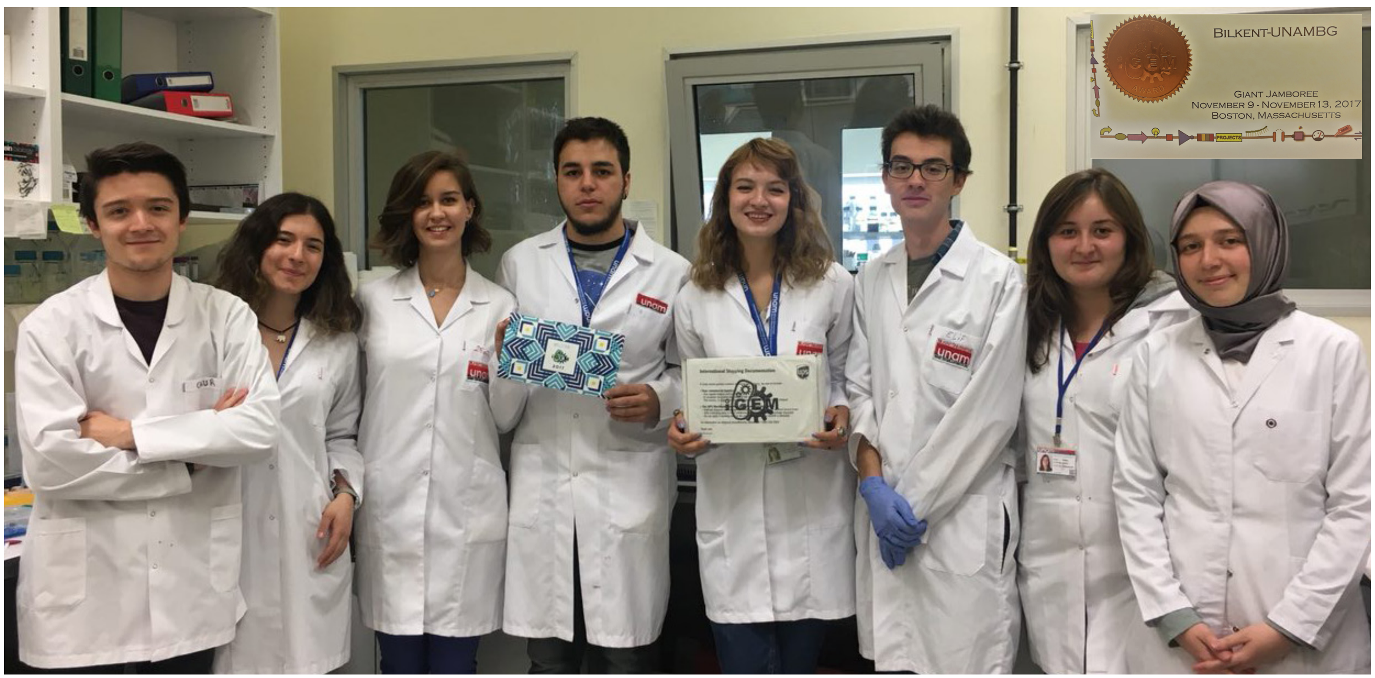
On the 7th of October, the second annual synthetic biology day was held at UNAM. The event was organized by Bilkent-UNAMBG iGEM2017 team and Bilkent Genetics Society. Dr. Ramez Daniel talked about circuit design for biomedical applications. Dr. Ozgur Sahin talked about metastasis of breast cancer. Dr. Emre Kacar explained computational methods via QSAR & RNA structure prediction. Dr. Urartu Seker talked about synthetic biology at the bio-nano interface. Prof. Fahim Farzadfard talked about dynamic genome engineering of living cells. Bilkent-UNAMBG Team presented their project for 2017 competition. Event attracted many participants ranging from PhD students to undergraduates from different backgrounds.

Bronze Medal at iGEM Giant Jamboree in US

Bilkent UNAMBG Team is formed by graduate and junior students working under the supervision of Asst. Prof. Dr. Urartu Ozgur Safak Seker, MSN and UNAM and Assoc. Prof. Dr. Isık Yulug, Department of Molecular Biology and Genetics and UNAM for the International Genetically Engineered Machine (iGEM) Competition. The team members include Aysenaz Ozanturk (MBG, graduate), Ezgi Dikici (MBG, junior), Ahmet Berk Urgen (MBG, junior), Simay Ayhan, (MBG, graduate), Artun Bulbul (MBG, junior), Busra Merve Kirpat (MBG, graduate), Eray Ulas Bozkurt (MBG, junior), Busra Nur Ata (MBG, junior), Azra Atabay (MBG , junior) and Mert Canatan (EE , senior).

The iGEM is a worldwide synthetic biology competition organized by the International Genetically Engineered Machine Foundation and Massachusetts Institute of Technology (MIT) since 2004. On November 13, Bilkent UNAMBG 2017 team was awarded a bronze medal for their project "DiagNOSE Cancer". The aim of the DiagNOSE Cancer project is to enable non-invasive diagnosis of lung, breast, colorectal and prostate cancer with a real-time breath test technique though volatile organic compounds (VOCs) in exhaled breath by designing biological circuits in bacteria. VOCs in exhaled breath make possible in vitro detection, classification and discrimination of disease because the concentration of specific VOCs in the breath samples may increase or decrease depending on the type of disease and microorganisms that are present.

For detailed project description and team information please visit: http://2017.igem.org/Team:Bilkent-UNAMBG



ACS NANO Best Poster Award at NaNaX8

Didem Dede, a MS graduate student of Demir Research Group in MSN program at Bilkent and UNAM, has been awarded with the ACS Nano Best Poster Award at NaNaX8, Nanoscience with Nanocrystals Conference in Portugal 2017, with the title of 'Colloidal Heterostructures of Nanoplatelets for Highly Tunable Excitonic Properties'. NaNaX8 brings together scientists of different research disciplines, in the fields of synthesis, characterization and applications of colloidal semiconductor nanocrystals and metal nanoparticles. Didem is photographed with the conference chair, Professor Andrey Rogach, ACS Nano Editor, after receiving her award.

Bilkent University

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