

Abdurrahman Gümüş, PhD

CONTACT INFORMATION	Assistant Professor Department of Electrical and Electronics Engineering Izmir Institute of Technology, Izmir, Turkey	<i>E-mail:</i> abdurrahmangumus@iyte.edu.tr <i>Phone:</i> +90 (232) 750 6528
RESEARCH INTERESTS	Machine Intelligence, Computational Neuroscience, Point-of-Care Biomedical Analysis	
ACADEMIC APPOINTMENTS	Izmir Institute of Technology , Izmir, Turkey: 2017 – Present Assistant Professor at Department of Electrical and Electronics Engineering King Abdullah University of Science and Technology (KAUST) , Thuwal, Saudi Arabia: 2015 – 2016 Post-Doctoral Fellow at Integrated Nanotechnology Laboratory Computer, Electrical and Mathematical Science and Engineering Division Cornell University , Ithaca, NY, USA: 2014 – 2015 Post-Doctoral Fellow at Erickson Laboratory Electrical and Computer Engineering	
EDUCATION	Cornell University , Ithaca, NY, USA M.S./Ph.D. in Electrical and Computer Engineering: 2008 – 2014 <i>Advisor:</i> Professor David Erickson <i>Areas of Study:</i> Lab on a Bird: <i>in-vivo</i> Real-Time Biophysical Monitoring of Birds; Solar thermal microfluidic systems for point of care diagnostics <i>Previous Advisor:</i> Professor George Malliaras <i>Area of Study:</i> Conducting polymer devices to control cell motility and adhesion Istanbul University , Istanbul, Turkey B.Sc. in Electrical and Electronics Engineering: 2001 - 2005 <i>Advisor:</i> Professor Aydın Akan <i>Area of Study:</i> Image and texture analysis	
AWARDS	Cornell Nanoscale Science and Technology Facility Graduate Student Fellowship, 2011 - 2014 - Participated several process developments and tool characterizations Honor of Distinguished Istanbul University Student, 2005 - Ranked 1 st in the Department of Electrical and Electronics Engineering	
PREVIOUS PRIMARY RESEARCH FOCUSES	Microfluidics-based wearable personalized medicinal platform A microfluidics-based wearable personalized medicinal platform was developed which has the capability to prepare (vary and mix multiple constituents) drugs on demand or with external stimuli through wearable body sensors. Adaptive drug preparation is critical for the personalization of medicine which would potentially decrease the cost of healthcare and increase the quality of life of patients. Wirelessly destructible high performance solid state electronics A new approach for physically transient electronics was developed which is simple, CMOS compatible, allows on command partial or total destruction, does not limit the life cycle of electronics and can provide destruction within 10 seconds of actuation. Demonstrated different destruction scenarios along with autonomous destruction including smartphone based operation. Lithography-less patterning of flexible electronic systems A new manufacturing method for flexible electronic systems was developed. By combining laser ablation and deep reactive ion etching (DRIE), high performance flexible electronic systems (patterned and thinned down to 40 µm) are fabricated.	

Solar-thermal complex sample processing for DNA based diagnostics in resource limited settings

A solar thermal sample preparation system is developed for DNA based diagnosis of infectious diseases such as cholera in resource limited settings. This system enables a complex sample processing in a way that easy to operate, and does not require any external energy input beyond ambient sunlight. We demonstrated the ability to use light energy to perform thermal lysing of the bacteria in large volumes, requiring only a few minutes to heat the system up to 95 °C, and the use of magnetic microbeads to isolate and remove the extracted nucleic acids. We also demonstrated the compatibility of the system with solar-PCR system, previously developed in Erickson Laboratory, and amplification analysis using smartphone application. When combined, these systems give us the ability to do rapid sample-in-answer-out in-field molecular diagnosis of cholera without the need for extensive laboratory equipment, chemicals or a dedicated power supply.

Lab on a Bird: *in-vivo* Real-Time Biophysical Monitoring of Birds

A biosensor system was developed that can continuously monitor *in vivo* subcutaneous uric acid levels of birds in a real time. Demonstrated the operation of the system by collecting *in-vivo* extracellular uric acid levels on a domestic chicken and flying pigeons. This biosensor system could open up a new way of studying the physiological state of the birds in their natural environments which would lead to a better understanding of avian biology.

Conducting polymer devices to control cell motility and adhesion

A conducting polymer device was developed to create a continuum of microenvironments for cell growth under the influence of an applied bias. Marked differences are observed in the cell migration and adhesion of bovine aortic endothelial cells as a function of location along the polymer stripe. Directional cell migration along the conducting polymer stripe was induced. A 3-fold variation is achieved in cell migration speed and directional persistence time.

JOURNAL
PUBLICATIONS

W. Babatain, **A. Gumus**, I. Wicaksono, U. Buttner, N. El-atab, M. Ur Rehman, N. Qaiser, D. Conchouso, M. M. Hussain, "Expandable Polymer Assisted Wearable Personalized Medicinal Platform" *Advanced Materials Technologies*, 5(10), (2020)

I. Yazgan, **A. Gumus**, K. Gökkuş, M. A. Demir, S. Evecen, H. A. Sönmez, R. M. Miller, F. Bakar, A. Oral, S. Popov, M. S. Toprak, "On the Effect of Modified Carbohydrates on the Size and Shape of Gold and Silver Nanostructures" *Nanomaterials*, 10(7), (2020)

R. R. Bahabry, A. N. Hanna, A. T. Kutbee, **A. Gumus**, M. M. Hussain, "Impact of Nickel silicide Rear Metallization on Series Resistance of Crystalline Silicon Solar Cells" *Energy Technology*, 6(9), (2018)

S. M. Khan, **A. Gumus**, J. M. Nassar, M. M. Hussain, "CMOS Enabled Microfluidic Systems for Affordable Personalized Healthcare Applications" *Advanced Materials*, 30(16), (2018)

A. T. Kutbee, R. R. Bahabry, K. O. Alamoudi, M. T. Ghoneim, M. D. Cordero, A. S. Almuslem, **A. Gumus**, E. M. Diallo, J. M. Nassar, A. M. Hussain, N. M. Khashab, M. M. Hussain, "Smart Personalized Dental Brace With Laser Based Bone Regeneration And Enhanced Enamel Healthcare", *npj Flexible Electronics*, 1(1), (2017)

A. Gumus, A. Alam, A. Hussain, K. Mishra, I. Wicaksono, G. T. Sevilla, S. F. Shaikh, M. Diaz, S. Velling, S. M. Ahmad, M. T. Ghoneim, M. M. Hussain, "Expandable Polymer Enabled Wirelessly Destructible High Performance Solid State Electronic" *Advanced Materials Technologies*, 2(5), (2017)

K. T. Lee, Y. Yao, J. He, B. Fisher, X. Sheng, L. Xu, M. A. Anderson, Y. Kang, **A. Gumus**, R. R. Bahabry, J. W. Lee, U. Paik, N. D. Bronstein, A. P. Alivisatos, S. Burroughs, M. M. Hussain, J. C. Lee, R. G. Nuzzo, J. A. Rogers, "Concentrator photovoltaics module architectures with capabilities for capture and conversion of full global solar radiation" *Proceedings of National Academy of Sciences (PNAS)*, 11(52), (2016)

G. A. T. Sevilla, A. S. Almuslem, **A. Gumus**, A. M. Hussain, M. E. Cruz, and M. M. Hussain, "High Performance High-κ/Metal Gate CMOS Circuit Element on Flexible Silicon" *Appl. Phys. Lett.*, 108, (2016)

S. Ahsan, **A. Gumus**, D. Erickson, "Stacked Waveguide Reactors with Gradient Embedded Scatterers for High-Capacity Water Cleaning" *Optics Express*, 23(24), (2015)

A. Gumus, S. Ahsan, B. Dogan, L. Jiang, R. Snodgrass, A. Gardner, Z. Lu, K. Simson, D. Erickson, "Solar-Thermal Complex Sample Processing for Nucleic Acid Based Diagnostics in Limited Resource Settings" *Biomedical Optics Express*, 7(5), (2015)

S. Ahsan, **A. Gumus**, A. Jain, L.T. Angenent, D. Erickson "Integrated Hollow Fiber Membranes for Gas Delivery into Optical Waveguide Based Photobioreactors." *Bioresource Technology*, 192(8), (2015).

A. Gumus, S. Lee, K. Karlsson, R. Gabrielson, C. Guglielmo, D. Winkler, D. Erickson, "Lab-on-a-Bird: Biophysical monitoring of flying birds" *PLOS One*, 10(4), (2015)

D. Erickson, D. O'Dell, L. Jiang, V. Oncescu, **A. Gumus**, S. Lee, M. Mancuso, S. Mehta "Smartphone Technology can be Transformative to the Deployment of Lab-on-Chip Diagnostics" *Lab-on-a-Chip*, (2014)

A. Gumus, S. Lee, K. Karlsson, R. Gabrielson, D. Winkler, D. Erickson, "Real-Time *in-vivo* Uric Acid Biosensor System for Biophysical Monitoring of Birds" *Analyst*, 139, (2014)

V. Oncescu, S. Lee, **A. Gumus**, K. Karlsson, D. Erickson, "Autonomous Device for Application in Late-Phase Hemorrhagic Shock Prevention" *PLOS-One*, 9(2), (2014)

S. Syed, **A. Gumus**, D. Erickson, "Redox Mediated Photocatalytic Water-Splitting in Optofluidic Microreactors" *Lab-on-a-Chip*, 13, (2013)

A. Gumus, J. P. Califano, A. Wan, J. Huynh, C. A. Reinhart-King, G. G. Malliaras, "Control of Cell Migration using a Conducting Polymer Device" *Soft Matter*, 6, (2010)

(Featured as a joint *Soft Matter* and *Journal of Materials Chemistry* themed issue on Tissue Engineering)

A. Wan, D. J. Brooks, **A. Gumus**, C. Fishbach, G. G. Malliaras, "Electrical Control of Cell Density Gradients on a Conducting Polymer Surface" *Chem Commun.*, 35, (2009)

SELECTED
CONFERENCE
PUBLICATIONS AND
PRESENTATIONS

A. Gumus, A. Alam, A. M. Hussain, K. Mishra, I. Wicaksono, G. A. Torres Sevilla, S. F. Shaikh, M. Diaz, S. Velling, M. T. Ghoneim, S. M. Ahmed, M. M. Hussain, "Destructible High Performance Solid State Electronics" 13th Nanoscience and Nanotechnology Conference (NanoTR13), Antalya, Turkey, October 2017

Gumus, A., Lee, S., Karlsson, K., Gabrielson, R., Winkler, D., Erickson, D., "Real-time biosensor system for biophysical monitoring of birds" *MicroTAS 2013 – The 17th International Conference on Miniaturized Systems for Chemistry and Life Sciences*, Freiburg, Germany, October 2013

Gumus, A., Winkler, D., Erickson, D., "Lab on a Bird: Autonomous microsystems for in-vivo real-time biophysical monitoring of birds" *MicroTAS 2011 – The 15th International Conference on Miniaturized Systems for Chemistry and Life Sciences*, Seattle, WA, USA, October 2011

Gumus, A., Califano, J. , Wan, A., Huynh, J., Reinhart-King, C., Malliaras, G., "Electrical control of cell migration on a conducting polymer surface", *Biomedical Engineering Society*, Seattle, WA, October 2010

Gumus, A., Malliaras, G.G., "Rapid detection of enteric pathogens using organic electrochemical transistors" *SPIE Optics and Photonics*, San Diego, CA, August 2009

TEACHING

Izmir Institute of Technology

EE201 Circuit Analysis 1

EE202 Circuit Analysis 2

EE565 Biomedical Instrumentation

EE572 Nanoscience and Nanotechnology