

# Abdurrahman Gümüş, PhD

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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	Bioelectronics, Biosensors, Smartphone-Based Biomedical Analysis, Preventative Healthcare Solutions, Microfluidics, Nanobiotechnology, Organic Bioelectronics, Flexible Electronics	
ACADEMIC APPOINTMENTS	<b>Izmir Institute of Technology, Izmir, Turkey:</b> 2017 – Present Assistant Professor at Department of Electrical and Electronics Engineering  <b>King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia:</b> 2015 – 2016 Post-Doctoral Fellow at Integrated Nanotechnology Laboratory Computer, Electrical and Mathematical Science and Engineering Division  <b>Cornell University, Ithaca, NY, USA:</b> 2014 – 2015 Post-Doctoral Fellow at Erickson Laboratory Electrical and Computer Engineering	
EDUCATION	<b>Cornell University, Ithaca, NY, USA</b> <b>M.S./Ph.D.</b> 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  <b>Istanbul University, Istanbul, Turkey</b> <b>B.Sc.</b> in Electrical and Electronics Engineering: 2001 - 2005 <i>Advisor:</i> Professor Aydin 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  Ministry of National Education of Turkey, 2008 – 2013 - Fellowship for Graduate studies in the USA  Honor of Distinguished Istanbul University Student, 2005 - Ranked 1 <sup>st</sup> in Department	
PREVIOUS PRIMARY RESEARCH FOCUSES	<b>Microfluidics-based wearable personalized medicinal platform</b> 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.  <b>Wirelessly destructible high performance solid state electronics</b> 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.  <b>Lithography-less patterning of flexible electronic systems</b> A new manufacturing method for flexible electronic systems was developed. By combining laser ablation and deep reactive ion etching (DRIE), complete high performance flexible electronic systems (patterned and thinned down to 40 µm) are achieved.	

### **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.

#### OTHER EXPERIENCES

**Yeditepe University**, Istanbul, Turkey,

Department of Electrical and Electronics Engineering: 2005-2007

Graduate Research and Teaching Assistant

Research Topics: Texture analysis methods for biomedical image processing

Teaching: Communication Systems Laboratory, Digital Signal Processing Lab. and Image Proc. Lab.

**Istanbul University**, Istanbul, Turkey

Department of Electrical and Electronics Engineering: 2004-2005

Undergraduate Teaching Assistant

Teaching: Communication Theory Laboratory I-II

#### JOURNAL PUBLICATIONS

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" *submitted* (2017)

**A. Gumus**, R. Bahabry, D. Conchouso, G. Sevilla, U. Buttner, M. M. Hussain, "Microfluidics-based wearable personalized medicinal platform" *submitted*, (2017)

S. M. Khan, **A. Gumus**, J. M. Nassar, M. M. Hussain, "CMOS Enabled Microfluidic Systems for Affordable Personalized Healthcare Applications" *Advanced Materials Accepted* (2017)

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- $\kappa$ /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, 14, (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" 13<sup>th</sup> 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 17<sup>th</sup> 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 15<sup>th</sup> 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 (BMES), 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