

KOÇ
ÜNİVERSİTESİ

RESEARCH ACTIVITIES
MECHANICAL CHARACTERIZATION LAB
2022

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Prof. B. ERDEM ALACA

Mechanical Engineering

Ph. D., 2003, University of Illinois at Urbana-Champaign, IL, USA

M.S., 1999, University of Illinois at Urbana-Champaign, IL, USA

B.S., 1997, Boğaziçi University, Istanbul, Turkey

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AFFILIATIONS

- Associate Vice President for Research & Development
- Director, Sponsored Research Office
- Director, Mechanical Characterization Laboratory
- Deputy Director, N2STAR, Nanofabrication and Nanofabrication Research Center for Scientific and Technological Advanced Research
- KUYTAM, Surface Science and Technology Center
- KUTTAM, Research Center for Translational Medicine

RESEARCH AREAS

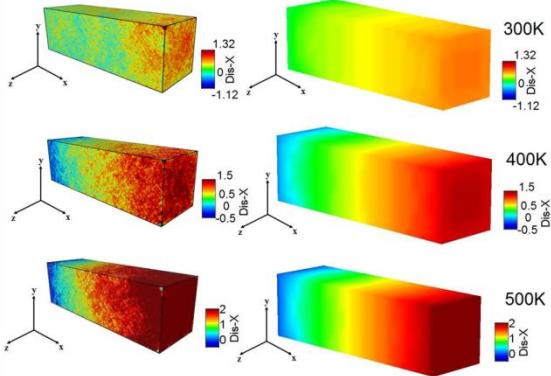
Nanoelectromechanical systems (NEMS)-based high-performance devices, micro and nanofabrication, mechanical characterization at micro and nanoscale, mechanics of tissues and soft materials.

HIGHLIGHTS

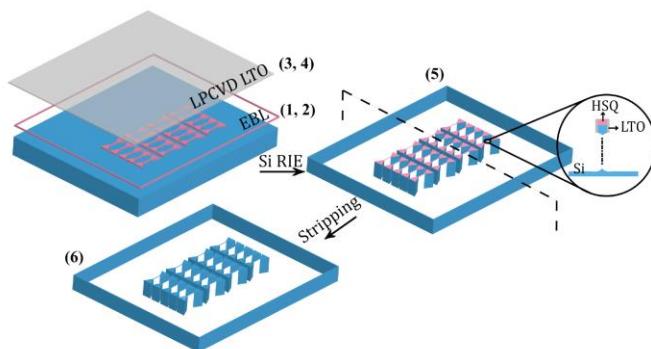
- Projects supported by TÜBİTAK, EURAMET, ISTKA
- 100+ refereed publications
- Elginkan Foundation Technology Award, 2017
- Turkish Academy of Sciences, Distinguished Young Scientist Award, 2009

Probing Mechanics at the Nanoscale

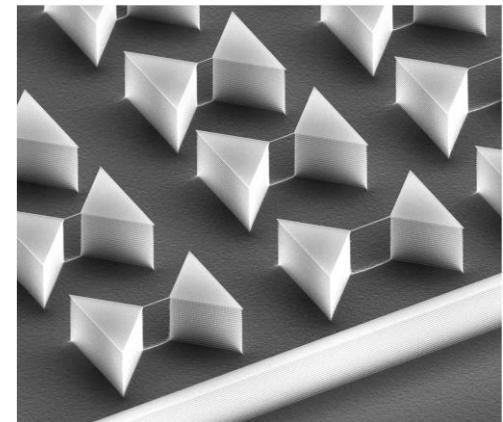
Modeling



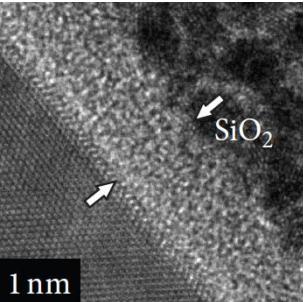
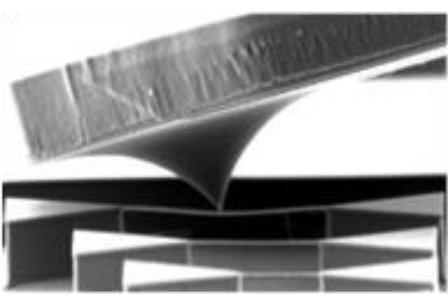
Technology Development



Fabrication



Measurement



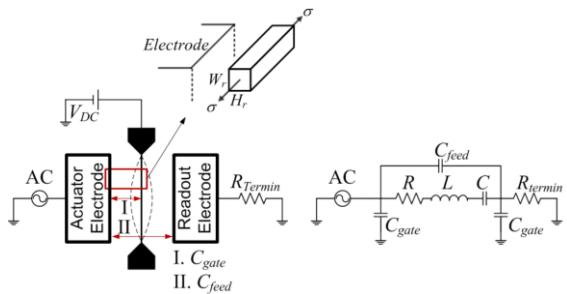
Representative Publications

1. S. Zare Pakzad, M. Nasr Esfahani, Z. Tasdemir, N. Wollschlaeger, X.F. Li, T. Li, M. Yilmaz, Y. Leblebici, and B. E. Alaca, "A New Characterization Approach to Study the Mechanical Behavior of Silicon Nanowires", *MRS Advances*, **6**, 500–505 (2021).
2. S. Dolabella, R. Frison, G. A. Chahine, C. Richter, T. Schulli, Z. Tasdemir, B. E. Alaca, Y. Leblebici, A. Dommann, and A. Neels, "Real and Q space traveling: multi-dimensional distribution maps of strain and crystal lattice tilt of suspended monolithic silicon nanowire structures", *Journal of Applied Crystallography*, **53** (2020).
3. M. Nasr Esfahani and B. E. Alaca, "A Review on Size-Dependent Mechanical Properties of Nanowires", *Advanced Engineering Materials*, **21**, 1900192 (2019).
4. M. Nasr Esfahani and B. E. Alaca, "Surface Stress Effect on Silicon Nanowire Mechanical Behavior: Size and Orientation Dependence", *Mechanics of Materials*, **127**, 112-123 (2018).
5. N. Wollschläger, Z. Tasdemir, I. Häusler, Y. Leblebici, W. Österle, and B. E. Alaca, "Determination of the elastic behavior of silicon nanowires within a scanning electron microscope", *Journal of Nanomaterials*, **2016**, 4905838 (2016).

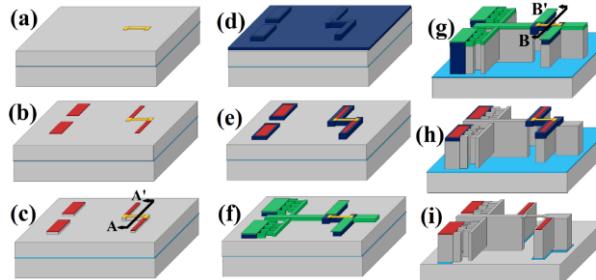
Collaborations: EMPA (Switzerland), EPFL (Switzerland), Fraunhofer (Germany), BAM (Germany)

Next-Generation Physical Sensors

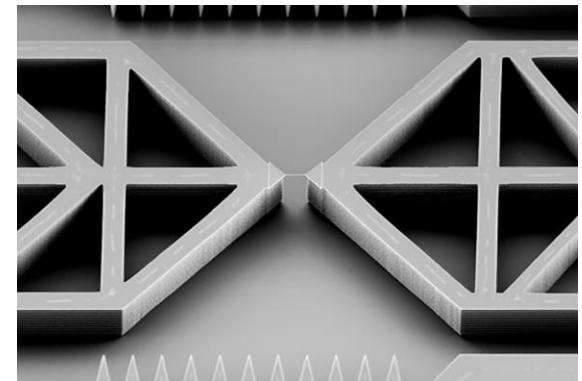
Modeling



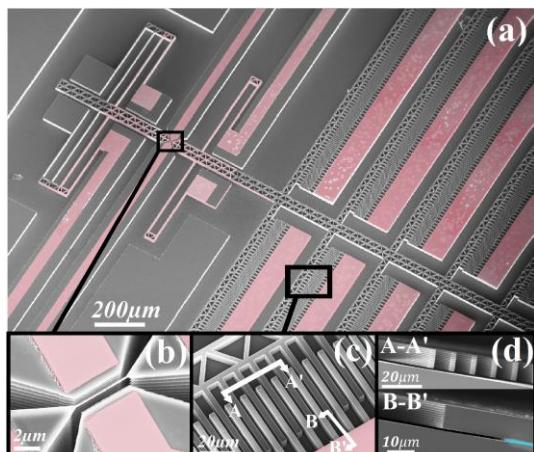
Technology Development



Fabrication



Proof of Concept



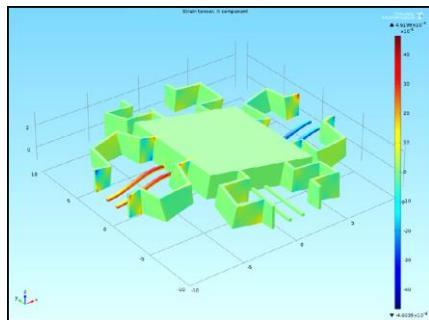
Representative Publications

1. Y. Kilinc, M. C. Karakan, Y. Leblebici, M. S. Hanay, and B. E. Alaca, "Observation of Coupled Mechanical Resonance Modes within Suspended 3D Nanowire Arrays", *Nanoscale*, **12**, 22042 – 22048 (2020).
2. M. Nasr Esfahani, Y. Kilinc, M. C. Karakan, E. Orhan, S. Hanay, Y. Leblebici, and B. E. Alaca, "Piezoresistive silicon nanowire resonators as embedded building blocks in thick SOI", *Journal of Micromechanics and Microengineering*, **28**, 045006 (2018).
3. M. Nasr Esfahani, M. Yilmaz, N. Wollschläger, I. W. Rangelow, Y. Leblebici, and B. E. Alaca, "Monolithic technology for silicon nanowires in high-topography architectures", *Microelectronic Engineering*, **183-184**, 42-47 (2017).
4. M. Yilmaz, Y. Kilinc, G. Nadar, Z. Tasdemir, N. Wollschläger, W. Österle, Y. Leblebici, and B. E. Alaca, "Top-down technique for scaling to nano in silicon MEMS", *Journal of Vacuum Science and Technology B*, **35**(2), 022001 (2017).
5. M. Nasr Esfahani, Y. Leblebici, and B. E. Alaca, "A Monolithic Approach to Downscaling Silicon Piezoresistive Sensors", *IEEE Journal of Microelectromechanical Systems*, **26**(3), 624-631 (2017).
6. B. E. Alaca, Y. Leblebici, I. Yorulmaz, Y. Kilinc, B. Aksoy, "A Nanomechanical Resonator Array and Production Method Thereof", US Patent no. 9,413,333, August 9, 2016.

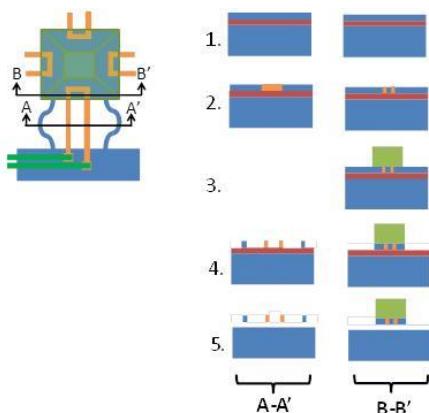
Collaborations: EPFL (Switzerland), TUIL (Germany)

Mechanics of Tissues and Soft Materials

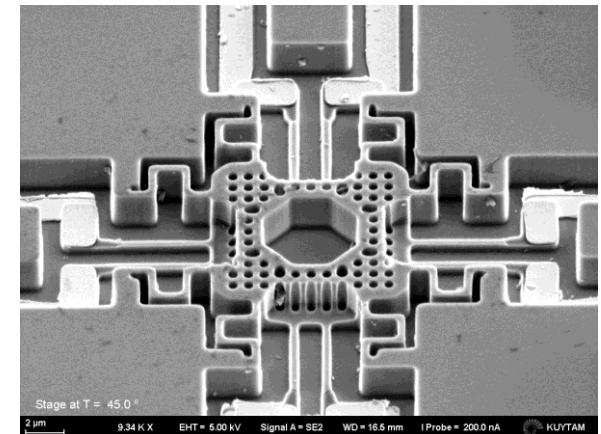
Modeling



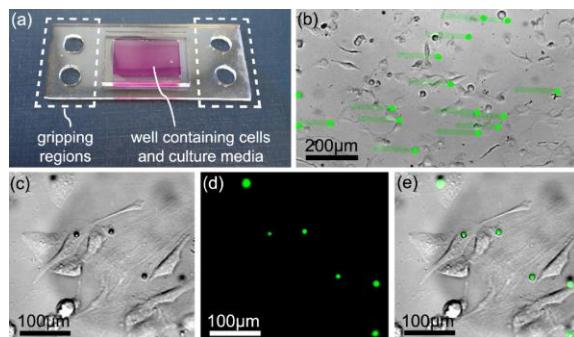
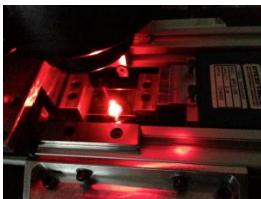
Technology Development



Fabrication



Measurement



Representative Publications

1. B. E. Alaca, H. Bayraktar, O. Aydin, "Multi-Axis Piezoresistive Force Sensor", US Patent no. 10,458,865, October 29, 2019.
2. A. S. Giz, S. Aydelik-Ayazoglu, H. Catalgil-Giz, H. Bayraktar, and B. E. Alaca, "Stress Relaxation and Humidity Dependence in Sodium Alginate-Glycerol Films", *Journal of the Mechanical Behavior of Biomedical Materials*, **100**, 103374 (2019).
3. S. Dogru, B. Aksoy, H. Bayraktar, and B. E. Alaca, "Poisson's ratio of PDMS thin films", *Polymer Testing*, **69**, 375-384 (2018).
4. B. Aksoy, A. Rehman, H. Bayraktar, and B. E. Alaca, "High-resolution Spatiotemporal Strain Mapping Reveals Non-uniform Deformation in Micropatterned Elastomers", *Journal of Micromechanics and Microengineering*, **27**, 045008 (2017).
5. O. Aydin, B. Aksoy, O. B. Akalin, H. Bayraktar, and B. E. Alaca, "Time-resolved local strain tracking microscopy for cell mechanics", *Review of Scientific Instruments*, **87**, 023905 (2016).

Collaborations: Wroclaw Univ Sci Technol (Poland), Bilgem

MCL At a Glance

Current Members

1 postdoc, 5 PhD students, 2 MS students



Alumni

5 PhD & 21 MS theses



In Numbers

Characterization and Fab facilities
800 m² clean area in N2Star
5 international projects
16 national projects
>11 M TL in funding
> 100 international publications

Sponsors & Collaborations



EMRP
European Metrology Research Programme
► Programme of EURAMET



The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union



BAM

Bundesanstalt für
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