

PEOPLE

Faculty

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Women in NSE

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Bilge Yildiz

Associate Professor of Nuclear Science and Engineering, and Associate Professor of Materials Science and Engineering

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Education

- Ph.D., Nuclear Science and Engineering, Massachusetts Institute of Technology, 2003.
- B.Sc., Nuclear Engineering, Hacettepe University Ankara, Turkey, 1999.

Research

Professor Bilge Yildiz's research centers on the science and technology of materials development for energy conversion applications in harsh environments. The scientific insights derived from her research impact the design of novel surface chemistries for efficient and durable solid oxide fuel/electrolysis cells, and for corrosion resistant films in a wide range of extreme environments as in nuclear energy generation and oil exploration. Her research has made significant contributions in advancing molecular-level understanding of the kinetics of oxygen reduction and oxidation on ionic solid surfaces. Specifically Prof. Yildiz studies the effects of temperature, stress and reactive fluids on the surface reactivity and degradation by combining theoretical and experimental analyses of electronic structure, defect mobility and composition, and provide design guidelines for high-performance and durable materials.

The key findings in much of Prof. Yildiz's work were obtained through the development of in situ surface science techniques in conjunction with first-principles calculations and novel atomistic simulations. The Yildiz laboratory develops and implements new scanning tunneling microscopy and spectroscopy capabilities in harsh in situ conditions of temperature, reactive gasses and mechanical stresses; a first-of-its kind capability. Her computational specialization includes development of new multiscale models to overcome the timescale limitation of traditional atomistic methods while coupling to the same atomistic length scales attainable in her experiments.

Recent Publications

1. Wen Ma, Jae Jin Kim, Nikolai Tsvetkov, Takeshi Daio, Yener Kuru, Zhuhua Cai, Yan Chen, Kazunari Sasaki, Harry L. Tuller and Bilge Yildiz, "Vertically Aligned Nanocomposite La_{0.8}Sr_{0.2}CoO₃/(La_{0.5}Sr_{0.5})₂CoO₄ Cathodes – Electronic Structure, Surface Chemistry and Oxygen Reduction Kinetics" *Journal of Materials Chemistry A, Journal of Materials Chemistry A*, 3, 207-219, 2015. DOI: 10.1039/C4TA04993D
2. F.W. Herbert, A. Krishnamoorthy, W. Ma, K.J. Van Vliet and B. Yildiz, "Dynamics of point defect formation, clustering and pit initiation on the pyrite surface" *Electrochimica Acta*, 127, 416-426, 2014. DOI: 10.1016/j.electacta.2014.02.048
3. B. Yildiz, " 'Stretching' the Energy Landscape of Oxides Inspired from Metals and Polymers: Effects of Elastic Strain on Surface Chemistry and Catalysis" *Materials Research Society Bulletin*, issue on Elastic Strain Engineering, 39 2, 147-156, 2014. DOI: 10.1557/mrs.2014.8
4. M. Youssef and B. Yildiz, "Predicting Self-Diffusion in Metal Oxides from First Principles: The Case of Oxygen in Tetragonal ZrO₂" *Physical Review B*, 89, 024105, 2014. DOI: 10.1103/PhysRevB.89.024105
5. F. W. Herbert, A. Krishnamoorthy, K. J. Van Vliet, B. Yildiz, "Quantification of electronic band gap

Research profiles:

New analysis shows ion slowdown in fuel cell material

Bilge Yildiz digs deep into surfaces of matter

Surface properties command attention

Designing Better Surfaces for Energy

Strain can alter materials' properties

Stress corrosion cracking: New experiments, new insights

Understanding and predicting materials behavior: NSE takes an interdisciplinary approach

New Insights Into Material Surfaces Advance Energy Conversion Technologies

Better Fuel Cells and Reactors, Built From the Atomic Level

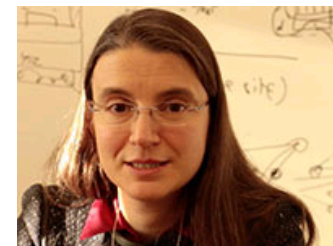
Labs + Groups

Yildiz Research Group

Department of Materials Science and Engineering

Consortium for Advanced Simulation of Light Water Reactors (CASL)

Video



Seeking Deep Understanding of Surfaces

Research Thumbnails :: Bilge Yildiz

Recent News

- and surface states on FeS₂(100)" *Surface Science*, 618, 53-61, 2013. DOI: 10.1016/j.susc.2013.08.014
6. Yue Fan, Yuri Osetsky, Sidney Yip and Bilge Yildiz, "Mapping Strain-rate Dependent Dislocation-Defect Interactions by Atomistic Simulations" *Proceedings of the National Academy of Sciences*, 110 44, 17756-17761, 2013. DOI: 10.1073/pnas.1310036110
 7. Wonyoung Lee, Jeong Woo Han, Yan Chen, Zhuhua Cai, Bilge Yildiz, "Cation Size Mismatch and Charge Interactions Drive Dopant Segregation at the Surfaces of Manganite Perovskites" *Journal of the American Chemical Society* 135 21, 7909-7925, 2013. DOI: 10.1021/ja3125349
 8. Yan Chen, Zhuhua Cai, Yener Kuru, Harry L. Tuller and Bilge Yildiz, "Electronic activation of cathode superlattices at elevated temperatures - source of markedly accelerated oxygen reduction kinetics" *Advanced Energy Materials* 3 9, 1221-1229, 2013. DOI: 10.1002/aenm.201300025
 9. Jeong Woo Han and Bilge Yildiz, "Mechanism for enhanced oxygen reduction kinetics at the (La,Sr)CoO_{3-δ}/(La,Sr)2CoO_{4+δ} hetero-interface" *Energy Environmental Science* 5, 8598-8607, 2012. DOI: 10.1039/C2EE03592H
 10. Zhuhua Cai, Markus Kubicek, Jürgen Fleig, and Bilge Yildiz, "Chemical Heterogeneities on La_{0.6}Sr_{0.4}CoO_{3-δ} Thin Films – Correlations to Cathode Surface Activity and Stability" *Chemistry of Materials* 24, 1116-1127, 2012. DOI: 10.1021/cm203501u
 11. Zhuhua Cai, Yener Kuru, Jeong Woo Han, Yan Chen, and Bilge Yildiz, "Surface Electronic Structure Transitions at High Temperature on Perovskite Oxides: The Case of Strained La_{0.8}Sr_{0.2}CoO₃ Thin Films" *Journal of the American Chemical Society* 133, 17696-17704, 2011. DOI: 10.1021/ja2059445

Teaching

- 22.101 Applied Nuclear Physics
- 22.70 Applications of Nuclear Materials
- 22.33/033 Nuclear Systems Design Project

Awards

- Charles W. Tobias Young Investigator Award, 2012
- Somiya Award for International Collaboration, 2012
- NSF CAREER Award, 2011 – 2016
- ANS Faculty PAI Outstanding Teaching Award, 05/2008
- Pacesetter Award, Argonne National Laboratory, 08/2006

Keeping hydrogen from cracking metals

Going to the Red Planet

Unleashing oxygen: 'Superlattice' could boost fuel cell performance

Probing the mysteries of cracks and stresses

MIT researchers shed light on atomic level factors responsible for the chemical expansion effect

NSE's Yildiz wins 2012 Charles W. Tobias Young Investigator Award

MIT research team wins Somiya Award for International Collaboration

Professor Bilge Yildiz wins MISTI Global Seed Fund grant

Prof. Bilge Yildiz wins prestigious NSF CAREER award

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