Stanford

# Dr. Arun Majumdar

Director, Precourt Institute for Energy, Jay Precourt Professor, Professor of Mechanical Engineering and of Photon Science and, by courtesy, of Materials Science and Engineering


**CONTACT INFORMATION**

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## Bio

### BIO

Dr. Arun Majumdar is the Jay Precourt Provostial Chair Professor at Stanford University, a faculty member of the Departments of Mechanical Engineering and Materials Science and Engineering (by courtesy) and co-Director of the Precourt Institute for Energy, which integrates and coordinates research and education activities across all seven Schools and the Hoover Institution at Stanford. He is also a faculty in Department of Photon Science at SLAC.

Dr. Majumdar's research in the past has involved the science and engineering of nanoscale materials and devices, especially in the areas of energy conversion, transport and storage as well as biomolecular analysis. His current research focuses on electrochemical and thermochemical redox reactions that are fundamental to a sustainable energy future, multidimensional nanoscale imaging and microscopy, and a new effort to re-engineer the electricity grid using data science, including deep learning techniques.

In October 2009, Dr. Majumdar was nominated by President Obama and confirmed by the Senate to become the Founding Director of the Advanced Research Projects Agency - Energy (ARPA-E), where he served till June 2012 and helped ARPA-E become a model of excellence and innovation for the government with bipartisan support from Congress and other stakeholders. Between March 2011 and June 2012, he also served as the Acting Under Secretary of Energy, enabling the portfolio that reported to him: Office of Energy Efficiency and Renewable Energy, Office of Electricity Delivery and Reliability, Office of Nuclear Energy and the Office of Fossil Energy, as well as multiple cross-cutting efforts such as Sunshot, Grid Tech Team and others that he had initiated. Furthermore, he was a Senior Advisor to the Secretary of Energy, Dr. Steven Chu, on a variety of matters related to management, personnel, budget, and policy. In 2010, he served on Secretary Chu's Science Team to help stop the leak of the Deep Water Horizon (BP) oil spill.

After leaving Washington, DC and before joining Stanford, Dr. Majumdar was the Vice President for Energy at Google, where he created several energy technology initiatives, especially at the intersection of data, computing and electricity grid.

Prior to joining the Department of Energy, Dr. Majumdar was the Almy & Agnes Maynard Chair Professor of Mechanical Engineering and Materials Science & Engineering at University of California–Berkeley and the Associate Laboratory Director for energy and environment at Lawrence Berkeley National Laboratory.

Dr. Majumdar is a member of the US National Academy of Engineering and the American Academy of Arts and Sciences. He served as the Vice Chairman of the Advisory Board of US Secretary of Energy, Dr. Ernest Moniz, and was also a Science Envoy for the US Department of State with focus on energy and technology innovation in the Baltics and Poland. He serves on the Science Board of Oak Ridge National Laboratory and is a member of the International Advisory Panel for Energy of the Singapore Ministry of Trade and Industry. He serves as an advisor to Envision Energy, Breakthrough Energy Ventures, First Light Fusion, the New Energy Group of Royal Dutch Shell and Lime Rock New Energy. He is a member of the Board of Directors of Cyclotron Road and the Electric Power Research Institute.

Dr. Majumdar received his bachelor's degree in Mechanical Engineering at the Indian Institute of Technology, Bombay in 1985 and his Ph.D. from the University of California, Berkeley in 1989.

## ACADEMIC APPOINTMENTS

- Professor, Mechanical Engineering
- Senior Fellow, Precourt Institute for Energy
- Professor, Photon Science Directorate
- Professor (By courtesy), Materials Science and Engineering
- Co-Director, Precourt Institute for Energy

## ADMINISTRATIVE APPOINTMENTS

- Director, Berkeley Nanoscience and Nanoengineering Institute, UC Berkeley, (2005-2008)
- Director, Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory, (2007-2009)
- Associate Laboratory Director for Energy and Environment, Lawrence Berkeley National Laboratory, (2009-2009)
- Acting Under Secretary of Energy, United States Department of Energy, (2011-2012)
- Founding Director, Advanced Research Projects Agency- Energy (ARPA-E)- United States Department of Energy, (2009-2012)

## HONORS AND AWARDS

- Energy Systems Award, American Institute of Aeronautics and Astronautics (2019)
- Fellow, Indian National Academy of Engineering (2014)
- Member, American Academy of Arts and Sciences (2013)
- Aurel Stodola Medal and Lecture, ETH Zurich (2010)
- Heat Transfer Memorial Award, American Society of Mechanical Engineers (2006)
- Member, United States National Academy of Engineering (2005)
- Miller Professorship, University of California, Berkeley (2003-2004)
- Distinguished Alumnus Award, Indian Institute of Technology, Bombay (2003)
- Fellow, American Association for the Advancement of Science (2002)
- Fellow, American American Society of Mechanical Engineers (2002)
- Gustus Larson Memorial Award, American Society of Mechanical Engineers (2001)

## BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Member, Selection Committee, Infosys Science Foundation (2012 - 2017)
- Member & Vice Chairman, Secretary of Energy's Advisory Board, Department of Energy (2014 - 2017)
- Member, Science Policy Board, Stanford Linear Accelerator Center (SLAC) (2014 - 2016)
- Science Envoy, US Department of State (2014 - 2015)

- Council Member, United States National Academy of Engineering (2014 - 2017)
- Member, Advisory Council, Electric Power Research Institute (2014 - 2018)
- Member, United States Delegation, US-India Track II Dialogue on Climate Change and Energy (2014 - 2016)
- Member, International Advisory Panel- Energy, Singapore Ministry of Trade and Industries (2014 - present)
- Member, Science Advisory Board, Oak Ridge National Laboratory (2014 - present)
- Member, Section 10 Peer Committee, United States National Academy of Engineering (2011 - 2014)
- Member, United States National Academy of Engineering Awards Committee (2009 - 2012)
- Member, Advisory Board, Nanoscience and Technology Institute, University of Central Florida (2008 - 2009)
- Chair and Member, Advisory Committee, NSF Engineering Directorate (2006 - 2009)
- Member, Advisory Board, Engineering Science, Sandia National Laboratories (2006 - 2008)
- Member, Nanotechnology Technical Advisory Group, President's Council of Advisers on Science and Technology (PCAST) (2003 - 2007)
- Member, External Advisory Board, NSF Center for Nanoscale Computing Network, Purdue University (2003 - 2006)
- Member, Council on Materials Science and Engineering, Basic Energy Science, Office of Science, Department of Energy (2002 - 2007)
- Founding Chair, Advisory Board, ASME Nanotechnology Institute (2001 - 2006)
- Member, Council on Energy and Engineering Research (CEER), Basic Energy Sciences, US Department of Energy (1998 - 2002)

### PROFESSIONAL EDUCATION

- PhD, University of California, Berkeley , Mechanical Engineering (1989)
- MS, University of California, Berkeley , Mechanical Engineering (1987)
- BTech, Indian Institute of Technology , Mechanical Engineering (1985)

### LINKS

- Magic Lab: http://web.stanford.edu/group/magiclab/home.html
- ME-16N: http://ME16N.stanford.edu

## Teaching

### COURSES

**2019-20**

- Heat Transfer: ME 131 (Aut)

**2018-19**

- Heat Transfer: ME 131A (Win)

**2017-18**

- Heat Transfer: ME 131A (Win)

**2016-17**

- Heat Transfer: ME 131A (Win)

### STANFORD ADVISEES

**Doctoral Dissertation Reader (AC)**

Jiafan Yu

**Postdoctoral Faculty Sponsor**

Haokun Li, Chenlu Xie

**Doctoral Dissertation Advisor (AC)**

Joel Martis, Jimmy Rojas, Eddie Sun, Shang Zhai, Ze Zhang

**Master's Program Advisor**

Amy Chi, Thomas Gill, Lisa Ishigame

**Doctoral Dissertation Co-Advisor (AC)**

Larissa Kunz

**Postdoctoral Research Mentor**

Haokun Li

**Doctoral (Program)**

Eddie Sun

## Publications

### PUBLICATIONS

- **Continuous electrochemical heat engines** *ENERGY & ENVIRONMENTAL SCIENCE*
  Poletayev, A. D., McKay, I. S., Chueh, W. C., Majumdar, A.
  2018; 11 (10): 2964–71
- **The use of poly-cation oxides to lower the temperature of two-step thermochemical water splitting** *ENERGY & ENVIRONMENTAL SCIENCE*
  Zhai, S., Rojas, J., Ahlborg, N., Lim, K., Toney, M. F., Jin, H., Chueh, W. C., Majumdar, A.
  2018; 11 (8): 2172–78
- **A dual-mode textile for human body radiative heating and cooling** *SCIENCE ADVANCES*
  Hsu, P., Liu, C., Song, A. Y., Zhang, Z., Peng, Y., Xie, J., Liu, K., Wu, C., Catrysse, P. B., Cai, L., Zhai, S., Majumdar, A., Fan, et al
  2017; 3 (11): e1700895
- **Heterodyne x-ray diffuse scattering from coherent phonons** *STRUCTURAL DYNAMICS*
  Kozina, M., Trigo, M., Chollet, M., Clark, J. N., Glownia, J. M., Gossard, A. C., Henighan, T., Jiang, M. P., Lu, H., Majumdar, A., Zhu, D., Reis, D. A.
  2017; 4 (5): 054305
- **Evaluation of a Silicon Sr-90 Betavoltaic Power Source** *SCIENTIFIC REPORTS*
  Dixon, J., Rajan, A., Bohlemann, S., Coso, D., Upadhyaya, A. D., Rohatgi, A., Chu, S., Majumdar, A., Yee, S.
  2016; 6
- **Sr Betavoltaic Power Source.** *Scientific reports*
  Dixon, J., Rajan, A., Bohlemann, S., Coso, D., Upadhyaya, A. D., Rohatgi, A., Chu, S., Majumdar, A., Yee, S.
  2016; 6: 38182-?
- **Elucidating the synergistic mechanism of nickel-molybdenum electrocatalysts for the hydrogen evolution reaction** *MRS COMMUNICATIONS*
  Mckay, I. S., Schwalbe, J. A., Goodman, E. D., Willis, J. J., Majumdar, A., Cargnello, M.
  2016; 6 (3): 241-246
- **Label-Free Electrical Detection of Enzymatic Reactions in Nanochannels.** *ACS nano*
  Duan, C., Alibakhshi, M. A., Kim, D., Brown, C. M., Craik, C. S., Majumdar, A.
  2016; 10 (8): 7476-7484
- **Nanoscale thermal transport. II. 2003-2012** *APPLIED PHYSICS REVIEWS*
  Cahill, D. G., Braun, P. V., Chen, G., Clarke, D. R., Fan, S., Goodson, K. E., Keblinski, P., King, W. P., Mahan, G. D., Majumdar, A., Maris, H. J., Phillpot, S. R., Pop, et al
  2014; 1 (1)

- **Crossover from incoherent to coherent phonon scattering in epitaxial oxide superlattices** *NATURE MATERIALS*
  Ravichandran, J., Yadav, A. K., Cheaito, R., Rossen, P. B., Soukiassian, A., Suresha, S. J., Duda, J. C., Foley, B. M., Lee, C., Zhu, Y., Lichtenberger, A. W., Moore, J. E., Muller, et al
  2014; 13 (2): 168-172
- **Opportunities and challenges for a sustainable energy future** *NATURE*
  Chu, S., Majumdar, A.
  2012; 488 (7411): 294-303
- **Nanostructured Thermoelectrics: Big Efficiency Gains from Small Features** *ADVANCED MATERIALS*
  Vineis, C. J., Shakouri, A., Majumdar, A., Kanatzidis, M. G.
  2010; 22 (36): 3970-3980
- **Nanowires for Enhanced Boiling Heat Transfer** *NANO LETTERS*
  Chen, R., Lu, M., Srinivasan, V., Wang, Z., Cho, H. H., Majumdar, A.
  2009; 9 (2): 548-553
- **Enhanced thermoelectric performance of rough silicon nanowires** *NATURE*
  Hochbaum, A. I., Chen, R., Delgado, R. D., Liang, W., Garnett, E. C., Najarian, M., Majumdar, A., Yang, P.
  2008; 451 (7175): 163-U5
- **Thermoelectricity in molecular junctions** *SCIENCE*
  Reddy, P., Jang, S., Segalman, R. A., Majumdar, A.
  2007; 315 (5818): 1568-1571
- **Rectification of ionic current in a nanofluidic diode** *NANO LETTERS*
  Karnik, R., Duan, C., Castelino, K., Daiguji, H., Majumdar, A.
  2007; 7 (3): 547-551
- **Solid-state thermal rectifier** *SCIENCE*
  Chang, C. W., Okawa, D., Majumdar, A., Zettl, A.
  2006; 314 (5802): 1121-1124
- **Thermal conductivity reduction and thermoelectric figure of merit increase by embedding nanoparticles in crystalline semiconductors** *PHYSICAL REVIEW LETTERS*
  Kim, W., Zide, J., Gossard, A., Klenov, D., Stemmer, S., Shakouri, A., Majumdar, A.
  2006; 96 (4)
- **Thermal conductance and thermopower of an individual single-wall carbon nanotube** *NANO LETTERS*
  Yu, C. H., Shi, L., Yao, Z., Li, D. Y., Majumdar, A.
  2005; 5 (9): 1842-1846
- **DNA translocation in inorganic nanotubes** *NANO LETTERS*
  Fan, R., Karnik, R., Yue, M., Li, D. Y., Majumdar, A., Yang, P. D.
  2005; 5 (9): 1633-1637
- **Electrostatic control of ions and molecules in nanofluidic transistors** *NANO LETTERS*
  Karnik, R., Fan, R., Yue, M., Li, D. Y., Yang, P. D., Majumdar, A.
  2005; 5 (5): 943-948
- **A 2-D microcantilever array for multiplexed biomolecular analysis** *JOURNAL OF MICROELECTROMECHANICAL SYSTEMS*
  Yue, M., Lin, H., Dedrick, D. E., Satyanarayana, S., Majumdar, A., Bedekar, A. S., Jenkins, J. W., Sundaram, S.
  2004; 13 (2): 290-299
- **Thermoelectricity in semiconductor nanostructures** *SCIENCE*
  Majumdar, A.
  2004; 303 (5659): 777-778
- **Thermal conductivity of individual silicon nanowires** *APPLIED PHYSICS LETTERS*
  Li, D. Y., Wu, Y. Y., Kim, P., Shi, L., Yang, P. D., Majumdar, A.

2003; 83 (14): 2934-2936

- **Nanoscale thermal transport** *JOURNAL OF APPLIED PHYSICS*
  Cahill, D. G., FORD, W. K., Goodson, K. E., Mahan, G. D., Majumdar, A., Maris, H. J., Merlin, R., Phillpot, S. R.
  2003; 93 (2): 793-818

- **Thermometry and thermal transport in micro/nanoscale solid-state devices and structures** *JOURNAL OF HEAT TRANSFER-TRANSACTIONS OF THE ASME*
  Cahill, D. G., Goodson, K. E., Majumdar, A.
  2002; 124 (2): 223-241

- **Thermal transport measurements of individual multiwalled nanotubes** *PHYSICAL REVIEW LETTERS*
  Kim, P., Shi, L., Majumdar, A., McEuen, P. L.
  2001; 87 (21)

- **Bioassay of prostate-specific antigen (PSA) using microcantilevers** *NATURE BIOTECHNOLOGY*
  Wu, G. H., Datar, R. H., Hansen, K. M., Thundat, T., Cote, R. J., Majumdar, A.
  2001; 19 (9): 856-860

- **Scanning thermal microscopy** *ANNUAL REVIEW OF MATERIALS SCIENCE*
  Majumdar, A.
  1999; 29: 505-585

- **MICROSCALE HEAT-CONDUCTION IN DIELECTRIC THIN-FILMS** *JOURNAL OF HEAT TRANSFER-TRANSACTIONS OF THE ASME*
  Majumdar, A.
  1993; 115 (1): 7-16

- **FRACTAL MODEL OF ELASTIC-PLASTIC CONTACT BETWEEN ROUGH SURFACES** *JOURNAL OF TRIBOLOGY-TRANSACTIONS OF THE ASME*
  Majumdar, A., BHUSHAN, B.
  1991; 113 (1): 1-11