

RUPAK CHAKRABORTY

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EDUCATION

- Massachusetts Institute of Technology**, S.M., Ph.D. candidate in Mechanical Engineering **2011-2016**
Major: Micro/nanomaterials engineering • *Minor:* Energy technology, policy, and entrepreneurship
Honors: National Science Foundation Graduate Research Fellow, MIT Energy Initiative Fellow
- Harvard University**, A.B. in Physics with minor in Computer Science **2006-2010**

EXPERIENCE

- MIT Photovoltaic Research Laboratory**, S.M., Ph.D. candidate (*Adviser:* Tonio Buonassisi) **2011 – 2016**
S.M. Thesis: Investigation of sub-bandgap absorption in iron pyrite
- Designed and built a sample chamber for *in-situ* resistivity and Hall effect measurements on single crystal iron pyrite under a sulfur atmosphere up to 440°C, allowing measurement of the bandgap
- Ph.D. Thesis:* Structural defect engineering of SnS thin-films for solar cells
- Demonstrated congruent evaporation of SnS with a custom-built thermal evaporation system, establishing a path towards facile manufacturing of SnS solar cells
 - Streamlined the SnS device fabrication process with a robust device layout, resulting in repeatable device performance and contributing to an NREL-certified record efficiency of 3.88% for thermally evaporated SnS-based photovoltaics (PV)
 - Co-fabricated hundreds of PV devices using thermal evaporation, H₂S annealing, sputtering, and atomic layer deposition
 - Determined the influence of SnS thin-film growth conditions on structural (XRD, SEM), electrical (resistivity, Hall effect), and PV device (*JV*, *QE*, *EBIC*, *SCAPS-ID*) properties, leading to a 34% improvement in device current
 - Designed and prototyped a first-of-its-kind sample heating stage for nanoscale microscopy of PV devices, enabling previously unattainable *in-situ* studies of nanoscale defects under industrially relevant processing conditions
 - Determined the structural incorporation of antimony dopant atoms in the crystal lattice of SnS using synchrotron X-ray absorption measurements, examining the feasibility of using antimony as a dopant in SnS PV devices
- MIT Course 2.626: Fundamentals of Photovoltaics**, Laboratory teaching assistant **Fall 2011**
- Led undergraduates in designing, fabricating, and characterizing their self-built solar cells
 - Developed a small-scale solar cell fabrication line for teaching purposes
 - Prototyped and built over 20 Arduino-based current-voltage measurement units with a user-friendly software interface
- Twin Creeks Technologies**, R&D intern **Spring 2011**
Company mission: To develop a kerf-less manufacturing process for low-cost crystalline silicon PV
- Developed automated imaging metrology for quantifying defects in silicon
 - Correlated silicon quality to process variables using statistical analysis in JMP
- Computational Chemistry Group, Harvard University**, Undergraduate researcher **2009 – 2010**
- Computationally simulated electron transport in photosynthetic complexes using a Monte Carlo approach to open quantum systems, implemented on a high-performance computing cluster
- Ultracold Atoms and Plasmas Group, Rice University**, Undergraduate researcher **Summer 2008**
- Created a mathematical model of the evaporative cooling of atoms in an optical dipole trap, enabling an experimental path toward the now-realized strontium Bose-Einstein condensate
 - Built and characterized an external cavity laser diode used for several experiments in the laboratory
- Center for Ultracold Atoms, Harvard University**, Undergraduate researcher **2007 – 2008**
- Designed, machined, and assembled critical components of a liquid-He-cooled cryostat with a sample chamber
 - Studied laser-ablated atomic vapor diffusion dynamics in the cryostat using laser absorption imaging

SKILLS

Computer: Statistical analysis (JMP), Optoelectronic simulation (SCAPS-ID), CAD (Autodesk Inventor, Simulation), Scientific computing (Mathematica, MATLAB, LSF), OOP (Java, C++), Electronics platform (Arduino), Image analysis (ImageJ)

Experimental: Thin-film growth and annealing (PVD, CVD), Materials characterization (microscopy, spectroscopy, electrical, etc.), Semiconductor device fabrication (cleanroom procedures), Hardware & electronics prototyping, Custom tool development

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SUPPORTING ACTIVITIES

- Solar Energy Technology and Innovation in Mexico Workshop**, Core organizer 2015
- Brought together 100+ participants from along the entire PV value chain, from R&D to installation
 - Moderated a panel on accelerating the pace of PV R&D
- MIT Energy Club**, Vice President 2015 – 2016
- Fostered collaboration between ten energy communities on campus and facilitated energy-related events
- MIT Undergraduate Research Opportunities Program**, Mentor 2014 – 2016
- Mentored two materials science undergraduate students in the experimental and data analysis methods involved with scanning electron microscopy and X-ray diffraction measurements
- MIT Energy Conference Team**, Sub-team leader 2010 – 2014
- Organized a public showcase of energy-related research as part of the 2011, 2012, and 2014 conferences

SELECTED PUBLICATIONS

“Development of an *in-situ* temperature stage for synchrotron X-ray spectromicroscopy”

R. Chakraborty, J. Serdy, B. West, M. Stuckelberger, B. Lai, J. Maser, M.I. Bertoni, M.L. Culpepper, T. Buonassisi, *Review of Scientific Instruments*, 86, 113705 (2015).

“Non-monotonic effect of growth temperature on carrier collection in SnS solar cells”

R. Chakraborty, V. Steinmann, N.M. Mangan, R.E. Brandt, J.R. Poindexter, R. Jaramillo, J.P. Mailoa, K. Hartman, A. Polizzotti, C. Yang, R.G. Gordon, T. Buonassisi, *Applied Physics Letters*, 106, 203901 (2015).

“Antimony-doped Tin(II) Sulfide Thin Films”

P. Sinsermsuksakul, R. Chakraborty, S.B. Kim, S.M. Heald, T. Buonassisi, R.G. Gordon, *Chemistry of Materials*, 24, 4556 (2012).

“3.88% efficient tin sulfide solar cells using congruent thermal evaporation”

V. Steinmann, R. Jaramillo, K. Hartman, R. Chakraborty, R.E. Brandt, J.R. Poindexter, Y.S. Lee, L. Sun, A. Polizzotti, H.H. Park, R.G. Gordon, T. Buonassisi, *Advanced Materials*, doi:10.1002/adma.201402219 (2014).

“Non-Markovian quantum jumps in excitonic energy transfer”

P. Rebentrost, R. Chakraborty, A. Aspuru-Guzik, *Journal of Chemical Physics*, 131, 184102 (2009).

JCP's Research Highlights

“Numerical modeling of collisional dynamics of Sr in an optical dipole trap”

A. Traverso, R. Chakraborty, Y.N. Martinez de Escobar, P.G. Mickelson, S.B. Nagel, M. Yan, T.C. Killian, *Physical Review A*, 83, 032705 (2011).

Note: Full publication record includes 12 peer-reviewed publications, 4 first-author conference contributions (on ResearchGate)

SELECTED PRESENTATIONS

“ V_{OC} impact of orientation-dependent electron affinity in anisotropic photovoltaic absorbers”

Oral presentation, Materials Research Society Fall Meeting (2015)

“Development of an *in-situ* temperature stage for synchrotron X-ray spectromicroscopy”

Live demo and oral presentation, Mechanical Engineering Research Exhibition (2015)

Esteemed Presenter Award for Excellence in Understanding

“Congruent evaporation of tin monosulfide for solar cell applications”

Oral presentation, Materials Research Society Fall Meeting (2013)

HOBBIES AND INTERESTS

Percussion and vocal composing, performing, teaching • Live sound mixing • Juggling • Home improvement/automation • Trekking