Sagnik Dasgupta

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EDUCATION

MS in Materials Science - Holman Research Group
Jan 2019 — Present

Arizona State University, Tempe

CGPA: 3.63/4.00 (Ongoing)

Bachelor of Science (Research) - Major in Material Science
Aug 2014 — Apr 2018

Indian Institute of Science, Bangalore

CGPA: 6.4/8.0

Senior Secondary Schooling
Apr 2010 — Mar 2012

Chettinad Vidyashram, Chennai

Score: 93.4%

STANDARDIZED TEST SCORES

GRE
Oct 2018

323 (164(Q)+158(V))

TOEFL (IBT)
Oct 2018

114

FIELDS OF INTERESTS

- Silicon Photovoltaics
- 2D materials
- Crystallography and Defects
- Semiconductor Optoelectronic Devices
- Characterization
- Transmission Electron Microscopy

RESEARCH PROJECTS

Theoretical Analysis of Partial Specific Contact Resistivity
Feb 2020 — Present

SEMTE, ASU **Prof. Zachary Holman; Dr. Arthur Onno**

The concept of partial specific contact resistivity has been shown to support a framework that can consistently explain passivation, conductivity and selectivity of contacts at open circuit as proposed by Onno et. al. (2019). This work involves extending this model to interpret behavior across the range of operating currents of the solar cell, especially maximum power point and short circuit. Using the principle of superposition, where extracting current from the device at operation should have the the same effect as a decrease in photogeneration at reduced illumination, it follows that information obtained on specific contact resistivities at open circuit should contain information about the complete behavior of the device at any operating point.

Novel Contacts for Silicon Heterojunction Solar Cells — Sep 2019 — Present

SEMTE, ASU — **Prof. Zachary Holman**

The goal of work is to investigate potential high and low work function materials to act as carrier selective contacts for silicon heterojunction based solar cells. The state of the art for conventional SHJ cells is to have doped aSi:H contacts for carrier selectivity. Further efficiency gains can be had by looking into highly doped wide bandgap materials with similar selectivity, but lower parasitic absorption than aSi:H. Simulations were performed on the package AFORS-HET showing promise for the use of wide bandgap amorphous/polycrystalline III-V semiconductors.

ITO as an Electron Contact for Tunnel-oxide Based Solar Cells — Jan 2019 — Present

SEMTE, ASU — **Prof. Zachary Holman**

Conventional double sided TOPCon structures use an ultra-thin tunneling SiOx layer for passivation with doped poly-Si as carrier selective contacts. The use of a poly-Si layer as the front contact of the cell, unfortunately leads to parasitic absorption of incoming radiation. This work, in collaboration with NREL, Colorado, aims to investigate the potential removal of the front n doped poly-SI layer, and use of a front ITO of sufficiently low work function as both the lateral transport layer as well as the carrier selective contact.

Bending Creep Test on Aluminum — Aug 2017 — Apr 2018

Dept. of Materials Engineering, IISc — **Prof. Vikram Jayaram**

This work involves the fabrication and creep testing of cantilever beams of commercially pure aluminum. Creep tests on cantilever beams involves bending creep. The main advantages of bending creep are that it is easier for small testing volumes and it reaches secondary creep faster. The aim of this work is to establish bending creep as a reliable alternative for uniaxial creep tests. Cantilever beams were machined out of commercially pure aluminum using Electrical discharge machining (EDM) and tested in a UTM at 250oC. Tests were performed at varying stresses to obtain a creep power law exponent of 3.6 with a 23% error. While the overall error is high, all data points except for a single outlier affirm an exponent of 4.5 as should be expected from the Weertman model.

An Experimental Overview of Photovoltaics — May 2017 — July 2017

IEK-5 (Photovoltaics), Forschungzentrum Jülich, Germany — **Dr. Friedhelm Finger**

This project involved exploration of various aspects of photovoltaics. Solar cell parameters for multi-junction thin film silicon solar cells were analysed over variation of angle of incident radiation and their efficiencies were compared. Further, the voltage generated by these cells were used on an electrolytic water splitting device to extract hydrogen gas. Using reference annual solar spectrum data, average photon energy was calculated and used to estimate the annual hydrogen production from these solar cells. On a second part of the project, the nature and quality of passivation of c-Si surfaces by a-Si:H was analysed for silicon heterojunction solar cells. This was done by calculation of the microstructural factor from the ratio of areas of the 2000 cm^{-1} and 2100 cm^{-1} peaks in the Raman Spectrum. Further comparisons were made to the spectra in the same range under FTIR. This served as an exposure to different techniques in spectroscopy, and ways to optimise signal to noise ratio.

Piezoresistive Strain Sensors — May 2016 — July 2016

Indian Institute of Science, Bangalore, India — **Prof. Srinivasan Raghavan**

This project involves the fabrication strain gauges using both metal thin films and using graphene. Gold thin films were sputtered on to triangular cantilevers made of PTFE and were loaded at the tip to impart strain. Change in resistance was measured as a function of strain. For graphene, the CVD grown graphene was transferred on to a similar triangular substrate with four gold contact pads sputtered on. Later wires were attached using silver epoxy and measurements were made on a Keithley 2450 SMU.

Electrochemical Delamination of CVD Grown Graphene — May 2015 — July 2015

Indian Institute of Science, Bangalore, India — **Prof. Srinivasan Raghavan**

Graphene, CVD grown on copper, needs to be transferred onto other substrates. In this project, I have looked into various methods of carrying out such transfers, in particular, electrochemical methods. One such method involves electrolysis of water and the subsequent generation of hydrogen bubbles between the graphene/PMMA stack and the copper substrate resulting in the graphene being mechanically delaminated from the copper. A bubble free method was also briefly explored.

Characterisation of DLC Thin Films Synthesized by PECVD — June 2014 — July 2014

Indira Gandhi Centre for Atomic Research, Kalpakkam, India — **Dr. M Kamruddin**

A Short introductory project on the synthesis of DLC thin films by the process of PECVD and methods of its characterisation including Raman Spectroscopy and SEM.

OTHER ACADEMIC ACTIVITIES

Term Papers

- Fractional Delay Filters in DSP **Dec 2017**
- Effect of Defects on Epitaxial Growth **Dec 2017**
- Polymer-Ceramic Composites for Strain Sensors **April 2017**
- Analysis of Loads and Stresses on Bicycle Frames **April 2016**

Teaching Assistant

Structure and Characterisation of Materials **Aug 2018 - Dec 2018**

NON ACADEMIC INITIATIVES

Coordinator for eSports tournament at Pravega 2016 February 2016

Lead a team to organize an eSports tournament at Pravega 2016. This involved interfacing with sponsors, managing computers and the network infrastructure, and hosting 100+ participants.

Lead Website designer for Pravega 2015 February 2015

Trained and lead a team of three to design the website of Pravega 2015, IISc's Technology and Cultural Fest organized by the undergrads.

AWARDS

Outstanding Teaching Assistant 2019

SEMTE Celebration of Excellence

JEE Advanced (formerly IITJEE) - 99.43rd percentile 2014

Joint Entrance Examination - Advanced

WBJEE - 99.86th percentile 2014

West Bengal Joint Entrance Examination

KVPY Fellowship - 99.72th percentile 2013

Kishore Vaigyanik Protsahan Yojna

NTSE Scholarship 2010

National Talent Search Examination

SKILLS

Programming Languages

- **Matlab**
- **C/C++**
- **Bash**
- **HTML+CSS+JS**

Technical skills

- **DC Sputtering (MRC 943/944)**
- **Electron Microscopy**

- **TEM (FEI CM-200)**
- **SEM (Phillips XL-30)**
- **FIB (FEI Nova 200 NanoLab)**

- **Light Optical Microscopy (Visible Light, Confocal)**
- **Spectroscopic Ellipsometry (Woollam M2000)**
- **UV-Vis Spectroscopy**
- **QSSPC (Sinton WCT-120)**
- **Photoluminescence**
- **Solar cell performance analysis (JV, EQE)**
- **Graphene Delamination**

Soft Skills

- **Teaching**
- **Presenting**
- **Experiment Design**
- **Team Leading**
- **Public Speaking**
- **Event Organization**

HOBBIES

- **Smartphone Photography**
- **Cycling**
- **Swimming**
- **Android Modding**
- **Web Development (HTML, CSS, JS)**

KEY COURSES TAKEN

Arizona State University

- **Advanced Thermodynamics**
- **Electron Microscopy I**
- **Electron Microscopy Lab I**

- **Electron Microscopy II**
- **Kinetics & Phase Transformations in Solids**
- **Fundamentals of Electrical, Optical, and Magnetic Materials & Device Applications**

- **Design of Engineering Experiments**
- **Structural & Mechanical Properties of Materials**
- **Manuscript Writing for Engineers (Audit)**

- **Advanced Silicon Processing**
- **Optoelectronic Devices**

Indian Institute of Science

- **Introductory Physics I: Mechanics, Oscillations and Waves (2:1)**
- **Analysis and Linear Algebra I (3:0)**
- **Physical Principles of Chemistry (Quantum Chemistry) (2:1)**
- **Algorithms and Programming (2:1)**

- **Introductory Physics II: Electricity, Magnetism and Optics (2:1)**
- **Analysis and Linear Algebra II (3:0)**
- **Basic Inorganic Chemistry (2:1)**
- **Introduction to Electrical and Electronics Engineering (2:1)**

- **Introductory Physics III: Thermal and Modern Physics (2:1)**
- **Introduction to Material Science (2:0)**
- **Probability and Statistics (3:0)**

- **Materials Thermodynamics (3:0)**
- **Structure of Materials (2:1)**
- **Mechanical Behavior of Materials (3:0)**
- **Fundamentals of Climate Science (2:1)**

- **Materials Kinetics (3:0)**
- **Mechanical Characterisation of Materials (1:1)**
- **Semiconductor Devices and Circuits (3:0)**
- **Corrosion (3:0)**
- **Material Synthesis (3:0)**
- **Polymer Science and Engineering (3:0)**

- **Functional Properties of Materials (3:0)**
- **Introduction to Materials Processing (2:1)**
- **Introduction to Materials Manufacturing (2:1)**
- **Organic Electronics (3:0)**
- **Introduction to Biomaterials (3:0)**

- **Solar Energy: Advanced Materials and Devices (3:0)**
- **Digital Signal Processing (3:0)**
- **Defects in Materials (3:0)**
- **Entrepreneurship, Ethics and Societal Impact (1:0)**

- **Control System Design (3:0)**
- **Technical Writing and Presentation (2:0)**

REFERENCES

Prof. Zachary Holman
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