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EDUCATION

02/2013 – Present Postdoctoral Fellow, The Molecular Foundry, Lawrence Berkeley National Laboratory, Berkeley, CA, USA.
09/2008 – 09/2012 Ph.D., Chemistry (Material Science), University of Limerick, Republic of Ireland.
07/2006 – 05/2008 M.Sc. Chemistry, Dr. B. R. Ambedkar National Institute of Technology Jalandhar, India.

SPECIAL COMPETENCIES AND INTERESTS

Inorganic Synthetic Chemistry:

- Colloidal synthesis of binary, ternary and quaternary (II-VI, CZTS/Se, CZGS/Se and CIGS/Se) semiconductor nanocrystals of various geometries (rod, particle, tetrapod and wire).
- Assembly of semiconductor nanorods and nanoparticle materials into 1D, 2D and 3D super-structure arrays over device scale area by self-assembly, liquid-air interface, electric field and electrophoretic assisted methods.
- Large-scale cation-exchange of CdS/Se nanorods into Ag₂S/Se and Cu₂S/Se.
- Device fabrication and analysis for solution-processed nanocrystal solar cell.
- Chemical bath deposition of buffer layer for nanocrystal thin film solar cell.
- Spin casting and electrophoretic deposition of inorganic photovoltaic materials (II-VI, CZTS/Se and CIGS/Se) for thin film solar cell fabrication.
- Temperature-dependent and time-resolved photoluminescence study of semiconductor nanorod (II-VI, CZTS/Se and CIGS/Se).
- Solution and spin cast approach for creating metal-semiconductor heterojunction (M = Au, Ag, Pt etc) nanomaterials.
- Solution synthesis of isotropic and anisotropic group IV semiconductor nanomaterials (Ge, Si) and Li ion storage analysis.
- Ge/Si nanocrystal modification of colloidal carbon black material.
- Surface functionalization by exchange and/or removal of phosphoric type ligands from II-VI semiconductor nanocrystals with amine and pyridine based surface passivants.
- Solution synthesis of metallic nanoparticles (Sn, Au, Ni and Co) and their directed assemble into lithographically pattern features.
- Facile Phase Transfer protocol for nanocrystal assemblies and their bio-imagine application.

Microscopy and Analytical Skills:

- Highly competent user of **JEOL JEM-2100F** and **JEM 2011** transmission electron microscopes including STEM, EDS and electron diffraction capabilities.
- Highly skilled user of a **Hitachi SU-70** and **FEI GEMINI** scanning electron microscopes including EBSD, EDS, attachments.
- Experienced in handling of **Cryo-stage** for temperature-dependent photoluminescence.
- Experienced in the data analysis and Rietveld refinement of XRD pattern.
- Adept operator of a PANalytical X'Pert PRO MPD.
- Proficient in the use and data analysis of: FTIR, PL, UV-vis, Solar Simulator, XPS, RAMAN and Zeta Potentiostat.

RESEARCH/WORK EXPERIENCE

02/2013 – Present Postdoctoral Fellow, The Molecular Foundry, Lawrence Berkeley National Laboratory, Berkeley, CA, USA.

- Investigation of Nanocrystal (Metal chalcogenides, Metal Oxide) based Materials as Electrodes and Absorbers in Nanocomposite Electrochromic Films, Lithium-ion batteries and solar cells.
- Development of new synthetic and assembly route toward multicomponent nanocrystal films.

09/2008 – 09/2012 PhD student, Material and Surface Science Institute, **University of Limerick**, Ireland.

Title of thesis: “*Synthesis & Assembly of Binary, Ternary & Quaternary Semiconductor Nanorods*”

Thesis supervisor: Kevin M Ryan, Material and Surface Science Institute, **University of Limerick**, Ireland.

11/2011 – 01/2013 SFI-Short Term Travel Fellowship, **Helmholtz-Zentrum Berlin for Materials and Energy**, Germany.

- Temperature-dependent photoluminescence study of semiconductor nanorod (CZTS/Se, CIS, CIGS/Se, CdS, CdSe).
- Development of absorber layer on Mo coated glass substrate by drop cast, electrophoreses and spins cast approach.
- Dark and light measurement by using solar simulator.
- Chemical bath deposition of buffer layer on sintered nanocrystal film.

01/2008 – 08/2008 Master Thesis, **Indian Institute of Technology Kanpur, India**.

Title of thesis: “*Synthesis and Characterization of water soluble carbon nanotube from waste carbon rich material*” under the guidance of **Prof. Sabyasachi Sarkar**.

HONORS AND AWARDS

- Recipient of **SFI-Short Term Travel Fellowship, 2011** for working in **Helmholtz-Zentrum Berlin for Materials and Energy**, Germany.
- Joint winner of **Wesley Cocker Award, 2011**, awarded through the Society of Chemical Industry.
- Recipient of **SRC SEC PhD Fellowship, 2008**, University of Limerick, Ireland.
- Recipient of **SURGE fellowship** for the summer internship at IIT Kanpur 2008, India.

PROFESSIONAL MEMBERSHIPS

- Current Member, Materials Research Society
- Current Member, Microscopy society of Ireland
- Current Member, European Microscopy Society

PUBLICATIONS

- **A. Singh**, N. J. English, K. M. Ryan. “Highly Ordered Nanorod Assemblies Extending Over Device Scale Areas and in Controlled Multilayers by Electrophoretic Deposition” *J. Phys. Chem. B* **2012**, *117*, 1608. (Highlighted in the Editor’s choice chemistry section of the December 2012 issue of *Science*. <http://www.sciencemag.org/content/338/6112/twil.full>)
- **A. Singh**, C. Coughlan, F. Laffir, K. M Ryan. “Assembly of CuIn_{1-x}Ga_xS₂ Nanorods into Highly Ordered 2D and 3D Superstructures” *ACS Nano* **2012**, *6*, 6977.

- **A. Singh**, C. Dickinson, K. M. Ryan. "Insight into the 3D Architecture and Quasicrystal Symmetry of Multilayer Nanorod Assemblies from Moiré Interference Patterns" *ACS Nano* **2012**, 6, 3339.
- **A. Singh**, H. Geaney, F. Laffir, K. M. Ryan. "Colloidal Synthesis of Wurtzite Cu₂ZnSnS₄ Nanorods and Their Perpendicular Assembly" *J. Am. Chem. Soc.* **2012** 134, 2910.
- **A. Singh**, K. M. Ryan. "Crystallization of Semiconductor Nanorods into Perfectly Faceted Hexagonal Superstructures." *Part Part Syst Charact* **2013**, Just accepted.
- **A. Singh**, R. D. Gunning, S. Ahmed, C. A. Barrett, N. J. English, J. -A. Garate, K. M. Ryan. "Controlled semiconductor nanorod assembly from solution: influence of concentration, charge and solvent nature" *J. Mater. Chem.* **2012**, 22, 1562.
- **A. Singh**, R. D. Gunning, A. Sanyal, K. M. Ryan. "Directing semiconductor nanorod assembly into 1D or 2D supercrystals by altering the surface charge" *Chem Commun.* **2010**, 46, 7193.
- C. Coughlan, **A. Singh**, K. M. Ryan. "Study into the Synthesis and Shape Development in Colloidal CuIn_xGa_{1-x}S₂ Nanocrystals." *Chem. Mater.* **2013**, 25, 653.
- T. Bala, **A. Singh**, A. Sanyal, C. O'Sullivan, F. Laffir, C. Coughlan, K. M. Ryan. "Fabrication of noble metal-semiconductor hybrid nanostructures using phase transfer" *Nano Research* **2013**, DOI 10.1007/s12274-013-0287-9.
- H. Geaney, C. Dickinson, C. O'Dwyer, E. Mullane, **A. Singh**, K. M. Ryan. "Growth of Crystalline Copper Silicide Nanowires in High Yield within a High Boiling Point Solvent System" *Chem. Mater.* **2012**, 24, 4319.
- H. Geaney, T. Kennedy, C. Dickinson, E. Mullane, **A. Singh**, K. M. Ryan. "Controlled Growth of Si Nanowires using a Simple Solution Based Approach" *Chem. Mater.* **2012**, 24, 2204.
- D. Kelly, **A. Singh**, C. A. Barrett, C. O'Sullivan, C. Coughlan, F. R. Laffir, C. O'Dwyer, K. M. Ryan. "A facile spin-cast route for cation exchange of multilayer perpendicularly-aligned nanorod assemblies" *Nanoscale* **2011**, 3, 4580.
- C. Barrett, **A. Singh**, J. Murphy, C. O'Sullivan, D. N. Buckley, K. M. Ryan. "Complete Synthesis of Germanium Nanocrystal Encrusted Carbon Colloids in Supercritical CO₂ and their Superhydrophobic Properties" *Langmuir* **2011**, 27, 11166.
- T. Bala, A. Sanyal, **A. Singh**, D. Kelly, C. O'Sullivan, F. Laffir, K. M. Ryan. "Silver tip formation on colloidal CdSe nanorods by a facile phase transfer protocol" *J. Mater. Chem.* **2011**, 21, 6815.
- J. -A. Garate, N. J. English, **A. Singh**, K. M. Ryan, D. A. Mooney, J. M. D. MacElroy. "Electrophoretic Deposition of Poly(3-decylthiophene) onto Gold-Mounted Cadmium Selenide Nanorods" *Langmuir* **2011**, 27, 13506.
- C. O'Sullivan, S. Crilly, F. R. Laffir, **A. Singh**, E. Magner, K. M. Ryan "Protein Immobilisation on Perpendicularly Aligned Gold Tipped Nanorod Assemblies" *Chem Commun.* **2011**, 47, 2655.
- C. O'Sullivan, R. D. Gunning, C. Barrett, **A. Singh**, Kevin M Ryan. "Size Control Growth of Gold Tip on II-VI Nanocrystal" *J. Mater. Chem.* **2010**, 20, 7875.
- A. Sanyal, T. Bala, S. Ahmed, **A. Singh**, F. Laffir, A. Pitterina, K. M. Ryan. "Water Dispersible Semiconductor Nanorod Assemblies via a Facile Phase Transfer and Their Application as Fluorescent Biomarkers" *J. Mater. Chem.* **2009**, 19, 8974.

CONFERENCE PROCEEDINGS

- S. Ahmed, C. A. Barrett, C. O'Sullivan, A. Sanyal, H. Geaney, **A. Singh**, R. D. Gunning and K. M. Ryan. 2009. Electrophoretic Deposition of Spherical and Rod-shaped Nanocrystals into Close Packed Superlattices. *Proceedings of 215th Electrochemical Society Meeting, ECS Transactions*, 19 (3), pp. 209-219.
- C. O'Sullivan, R. D. Gunning, C. A. Barrett, **A. Singh**, H. Geaney, A. Sanyal, S. Ahmed, T. Bala and K. M. Ryan. 2009. Facet Specific Gold Tip Growth on Semiconductor Nanorods. *Proceedings of 216th Electrochemical Society Meeting, ECS Transactions*, 25 (12), pp. 17-29.

PATENTS

- ❖ Process and System for Making Colloidal Carbon Spheres. C. A. Barrett, **A. Singh** and K. M. Ryan. Invention Disclosure submitted to INSPIRE, UL TTO. (28/06/2010).
- ❖ Process and System for Fabrication and Surface Modification of Colloidal Carbon Spheres in Supercritical Media. C. A. Barrett, **A. Singh** and K. M. Ryan. European Patent Application No. EP101919940.2. (22/11/2010).

ACADEMIC CONFERENCE PRESENTATIONS

- ❖ **A. Singh**, K. M. Ryan. "Crystallization of Semiconductor Nanorods into Perfectly Faceted Hexagonal Superstructures" MRS Spring Meeting, San Francisco, CA, USA, 2013. **(Poster)**
- ❖ **A. Singh**, S. Singh, S. Levenco, F. Laffir, T. Unold K. M. Ryan. "Shape, Composition and Crystal Phase Controlled Colloidal Synthesis of Earth Abundant Multicomponent Copper Chalcogenide Nanocrystal" MRS Spring Meeting, San Francisco, CA, USA, 2013. **(Poster)**
- ❖ **A. Singh** and K. M. Ryan. "Growth and Characterization of Nanocrystal Based Cu- chalcogenide Thin Films" Helmholtz-Zentrum Centre for Materials and Energy Research, Berlin, Germany, 2013. **(Invited talk)**
- ❖ **A. Singh**, C. Dickinson, K. M. Ryan. "Moiré Patterns Revealed in Semiconductor Nanorod Assemblies" NaNaX 5, Fuengirola, Spain, 2012. **(Poster, Winner of 2nd prize presented by ACSNANO, NANOLETTER and Langmuir)**
- ❖ **A. Singh** and K. M. Ryan. "Device-scale Multilayer Assembly of Vertical Aligned Semiconductor Nanorods by Electrophoresis" MRS Spring Meeting, San Francisco, CA, USA, 2012. **(Talk)**
- ❖ **A. Singh**, C. Dickinson, K. M. Ryan. "Moiré Patterns Revealed in Semiconductor Nanorod Assemblies" MRS Spring Meeting, San Francisco, CA, USA, 2012. **(Poster, Winner of best poster award in symposium BB)**
- ❖ **A. Singh** and K. M. Ryan. "Synthesis of Ternary and Quaternary Copper Chalcogenide Nanorods for Integration into Low-cost Solar Cells" MRS Spring Meeting, San Francisco, CA, USA, 2012. **(Poster)**
- ❖ **A. Singh** and K. M. Ryan. "Device-scale Multilayer Assembly of Vertical Aligned Semiconductor Nanorods by Electrophoresis" Smart Surfaces 2012 solar and Biosensor Applications, Dublin, Ireland, 2012. **(Talk)**
- ❖ **A. Singh** and K. M. Ryan. "Synthesis & Assembly of Semiconductor Nanorods Towards Low-Cost Solution Process able Solar cell" Institute Technology, Helmholtz-Zentrum Centre for Materials and Energy Research, Berlin, Germany, 2011. **(Invited talk)**
- ❖ **A. Singh**, C. Dickinson, K. M. Ryan. "Moiré Patterns Revealed in Semiconductor Nanorod Assemblies" Microscopy society of Ireland conference, Dublin, Ireland 2011. **(Talk, Winner of best talk award)**

- ❖ **A. Singh**, C. A. Barrett, H. Geaney, R. Gunning, K. M Ryan. “Modification of Germanium Nanowires with Semiconductor Quantum Dots: A New Photoanode Material” MRS Spring Meeting, San Francisco, CA, USA, 2011. **(Talk)**
- ❖ **A. Singh** and Kevin M Ryan. “Understanding Semiconductor Nanorod Assembly from Solution: Towards Aligned Nanorod Solar Cells” MRS Spring Meeting, San Francisco, CA, USA, 2011. **(Poster)**
- ❖ **A. Singh**, S. Ahmed, R. Gunning, Kevin M Ryan. “Aligned Nanorod for Solar Cell”, ESF Research Conference on Nanotechnology for Sustainable Energy, Obergurgl, Austria, 2010. **(Talk)**

WORKSHOPS / SUMMER SCHOOL

- Student attendee in the “**Summer School in Solar Energy Conversion 2011**” University College Dublin, Ireland.
- Student attendees in the “**International Summer School on Photovoltaic’s and New Concepts of Quantum Solar Energy Conversion**” Quantsol 2010, Hirschegg, Austria