Curriculum Vitae - Sonal Kumar

CONTACT INFORMATION

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EDUCATIONAL RECORD

Nanyang Technological University (NTU), Singapore [Aug '17 -Present]
Doctoral Candidate (PhD) | Materials Science and Engineering

Indian Institute of Technology Bombay (IITB), Mumbai, India [Jul '12 - Aug '17]
Bachelor and Master of Technology | Metallurgical Engineering & Materials Science

- CGPA 8.61/10 | Specialization in Ceramics & Composites

GRADUATE RESEARCH

PhD Thesis [Aug '17 -Present]
ALUMINUM-ION AQUEOUS BATTERIES | Energy Storage Lab, NTU
Guide: Prof. Madhavi Srinivasan, NTU

- Spearheading aluminum-ion battery research in the team while providing supportive leadership to fellow lab members in experiment designing, characterization expertise & equipment maintenance
- Responsible for studying the feasibility of aqueous aluminum-ion batteries and identifying the concomitant reaction mechanism for Al-ion insertion
- Created & implemented procedural steps (with risk assessments) for electrode material synthesis, cell fabrication, testing of batteries and postmortem analysis
- With a phased approach, synthesized & tested high-capacity cathode materials, engineered artificial protective layer on Al-metal anodes and optimized aqueous electrolyte to surpass contemporary battery performances
- Implemented a combination of in-house and synchrotron-based technique to study post-mortem cells and identified the possible mechanisms of reactions and/or cell failure
- Authored over 10 articles with effective and swift collaboration of local and international collaborators: Google Scholar Link

Master's Thesis [May '16 - Aug '17]
ZIRCONIA FOR DENTAL APPLICATION| Particulate Matter Lab, IITB
Guide: Prof. Parag Bhargava, IIT Bombay

- Reverse engineered various grades of commercial zirconia disks used in dental restoration to study its material aspects and identify key processing-parameters. This led to
  - evolution of technical reasons explaining the disparity in the performances
  - benchmarking the characteristics that make a superior quality disk
- Collaborated with industry to manufacture zirconia disk using lab-grown powder, targeting for indigenous production of high-quality disks to meet the demands of local dental labs

UG RESEARCH EXPERIENCE

Queensland University of Technology (QUT), Australia [May '15 - Jul '15]
SENSOR FABRICATION FOR CORROSION MONITORING | QUT
Guide: Prof. Geoffrey Will, Discipline Head, Energy & Processing Engineering, QUT

- Only student selected under the Vacation Research Experience Scheme of QUT to carry out research on sensor fabrication for corrosion monitoring
- Devised a series of electrical resistance-based sensors capable of providing continuous data to identify the magnitude and timing of all the corrosion upsets
- Developed monitoring technique for pitting corrosion by generating different Tafel curves for artificially created holes acting as a pit; proposed magnetic flux-based techniques to detect pitting

Processing and Fabrication Project [Apr '14 - Jul '14]
REFRACTORY CERAMIC FIBER | Particulate Matter Lab, IITB
Guide: Prof. Parag Bhargava, IIT Bombay

- Fabricated high-temperature resistant alumina fibers to be consolidated in the form of boards for industrial application as thermal barriers
- Implemented refluxing technique to obtain alumina gel from its precursor & determined its optimum viscosity with the theoretical understanding of Rayleigh instability
- Spun gel in a cotton candy machine like setup to obtain fibers; later optimized spinning process parameters to scale up fiber production by a factor of 2

Computational Modeling and Simulation Project [Oct '13 - Dec '14]
MOLECULAR DYNAMICS SIMULATION | Molecular simulation lab, IITB
Guide: Prof. A. S. Panwar, IIT Bombay

- Set up 30+ simulation systems, containing carbon nanotubes (CNT) embedded in an aqueous environment, to study the effect of radius of curvature, relative orientation and number of walls on the inter-particle interaction energy
- Programmed simulation code in open- source package LAMMPS & applied principle of thermodynamic perturbation to plot the potential mean curve for simulation systems
- Extensively used C++ & MATLAB to analyze and draw conclusive results from post-simulation data obtained; handled large volume of files simultaneously using basic bash scripting
- Published the finding as "Scaling relations for the interactions between curved graphene sheets in water"

MENTORING

Residential Mentor | Hall 11, Residential Education Program, NTU [Jul '19 - Present]

- Served as a friendly and helpful contact point for in-residence undergraduate students by advising and guiding them on welfare and pastoral care matters
- Liaised resident group's need and concerns to faculty-in-residence/ hall admin, and vice-versa
- Organized learning program and activities aimed at stimulating personal and intellectual growth of students; these included cooking classes, terrarium hands-on sessions and well-being workshops

Academic Mentor | Department Academic Mentorship Program, IITB [May '15 - Aug '17]

- Selected for a consecutive term based on overall profile and peer reviews; resolved socio-academic issues of students
- Structured course credit for 3 senior year students & mentored via one-to-one counselling
- Mentored 15 sophomores by guiding their academic & extracurricular endeavours
- Managed summer project allocation of materials science department & revamped course-wiki by consolidating curriculum review at one platform

Research Mentor | MSE, NTU [May '18 - Present]

- Trained and mentored 3 final year project (FYP) students and 2 high school students to conduct independent research in battery fabrication and testing lab
- Designed and structured their projects with careful assessments, providing a risk-free environment to work in the lab

POSITIONS OF RESPONSIBILITY

Vice President | Graduate Students' Club, NTU [Feb '19 - Dec '20]

- Provided leadership support in voicing the needs and concerns of graduate students to admin
- Communicated and delegated responsibilities among club members to optimally run the club
- Resolved intra-club conflicts and planned budget for the club organized activities
- Organized activities creating an interactive and vibrant space for graduate students to relax; these included events like freshmen orientation, appreciation dinner, graduate students' night, cultural talk, cleaners' appreciation day and alumni networking session

Convener | Materials Club, IIT Bombay [Feb '14 - Dec '14]

- Cofounded materials club of IITB; targeting to set up a community of core enthusiasts in the long run
- Organized technical training sessions targeting to enhance the skillsets of 150+ freshmen
- Independently developed low-cost PCBs at 4% of the market value for massive utilization
- Organized talks by professors and coordinated in arranging lab tours for freshmen; setup research interest groups (RIGs) to bring together people pursuing research in the same field
- Exhibited a collection of smart materials at annual department festival "Padarth"; enthused general public by explaining basic science and potential applications of materials

TEACHING

Lab Teaching Assistant | MSE, NTU [Jan '20 – Oct '20]
Course: Creep behaviour of materials; Micro-hardness of materials, Microscopy

- Planned course content, introduced the theory of the subject for lab sessions and graded reports
- Guided 20+ batches of UG students in conducting lab experimentation efficiently
- Demonstrated the working of scanning electron microscope for 15+ batches of UG students

Undergraduate Teaching Assistant | ME&MS, IIT Bombay [Jul '16 – Aug '17]
Course: Kinetics of Process, Advanced Ceramics

- Part of the team responsible for conducting help sessions, tutorials, evaluation & managing course work of 120+ registered UG students

INDUSTRIAL INTERNSHIP

TREELABS | Mumbai [May '13 - Jun '13]

- Carried out a series of casting experiments to conduct an in-depth study of a newly developed desktop furnace by TREELABS named "Melt It"
- Identified features & shortcomings of the furnace and recommended possible modifications
- Compiled a report cum guide-book on casting using "Melt It" for use in high school and undergraduate courses

SCHOLASTIC ACHIEVEMENTS

- Scored a 99.98% percentile in IIT JEE entrance exams, competing 500,000 students ['12]
- Recipient of Institute Academic Excellence Award; given to top 2 annual performers in the department for exceptional academic performance ['14]
- One of three amongst 120+ student to receive Undergraduate Research Award for developmental research efforts in Molecular Dynamics Simulation of nano-materials ['14]
- Three-minute thesis (3MT), Padarth - Secured 1st position countrywide at Annual Research Communication competition for presenting work on the fabrication of alumina fibers ['16]

TECHNICAL PROFICIENCY

Materials Characterization

- In-situ X-ray diffraction, X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), Energy Dispersive Spectroscopy (EDS), X-ray Photoelectron Spectroscopy (XPS), Raman Spectroscopy, Infrared Spectroscopy, UV-visible Spectroscopy, Thermogravimetric Analysis

Battery

- Equipment: Neware, Solartron, Arbin, Princeton
- Techniques: Galvanostatic cycling, Cyclic Voltammetry (CV), Electrochemical Impedance Spectroscopy (EIS)

Synchrotron

- XAS beamline
- Tools: ATHENA, ARTEMIS
- Workshop: Asian conference on X-ray absorption spectroscopy, 2019, Thailand

Computer skills

- Programming: C++, MATLAB, Bash Scripting
- Simulation: LAMMPS, VMD, TOPAS
- Publishing: Microsoft Office, Xmgrace, Origin, Endnote, Vesta

EXTRA-CURRICULAR ACTIVITIES

Social Outreach

- Liter of light- Installed 120 solar bulb models catering needs of 500 people in slums of Mumbai
- Documented short film highlighting the ill effects of caste system in rural India

Adventure and Sports

- Active Squash player, basic training in boxing & trekking enthusiast; 10+ trek in Western Ghats of India

Professional Training

- Basic helping skills training by Wellbeing Centre, NTU, Singapore
- Soft skills training by Tata Institute of Social Sciences (TISS), India

SELECTED PUBLICATIONS

[1] **S. Kumar**, V. Verma, W. Manalastas, et al., *ACS Applied Energy Materials* **2020**, *3*, 8627-8635
[2] **S. Kumar**, R. Satish, V. Verma, H. Ren, et al., *J. Power Sources* **2019**, *426*, 151-161
[3] **S. Kumar***, V. Verma*, R. Chua, H. Ren, et al., *Batteries & Supercaps* **2020**, *3*, 619-630
[4] Y. Cai*, **S. Kumar***, R. Chua, V. Verma, et al., *J. Mater. Chem. A* **2020**, *8*, 12716-12722
[5] V. Verma*, **S. Kumar***, W. Manalastas Jr, R. Satish, et al., *Adv. Sustainable Syst.* **2019**, *3*, 1800111
[6] **S. Kumar**, P. Rama, A. S. Panwar, *Phys. Chem. Chem. Phys.* **2017**, *19*, 30217-30226
[7] W. Manalastas Jr, **S. Kumar**, V. Verma, L. Zhang, et al., *ChemSusChem* **2019**, *12*, 379-396
[8] V. Verma, R. M. Chan, L. Jia Yang, **S. Kumar**, et al., *Chem. Mater.* **2021**
[9] D. Yuan, J. Zhao, W. Manalastas, **S. Kumar**, et al., *Nano Materials Science* **2020**, *2*, 248-263
[10] V. Verma, **S. Kumar,** W. Manalastas, et al., *ACS Applied Energy Materials* **2019**, *2*, 8667-8674
[11] R. Chua, Y. Cai, P. Q. Lim, **S. Kumar**, et al., *ACS Appl. Mater. Interfaces* **2020**, *12*, 22862-22872

* Equal contributions from first two authors | Full Publication list on - Google Scholar Link