VIR KARAN

University of California, Berkeley

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Education

University of California, Berkeley, CA   2023-2028 (Expected)

PhD Candidate, Materials Science & Engineering   *Advisor: Dr Kristin Persson*

Indian Institute of Technology Madras   2019-2023

B.Tech, Metallurgical & Materials Engineering   *CGPA: 9.33/10, Department Rank: 1*

Scholastic Achievements

- Awarded the prestigious **MITACS Globalink Fellowship** to take up an international research project in Canada (2022)
- Selected for the coveted **Young Research Fellowship** at IIT Madras amongst **200+** applicants (2021-2022)
- Nominated for the **O**P **J**indal **E**ngineering & **M**edical **S**cholarship for meritorious students (2019 & 2022)
- Secured a percentile of **99.85%** in **J**oint **E**ntrance **E**xam Main among **1.4 million+** candidates (2019)

Publications

- "Optimization of the deposition process parameters of DC magnetron sputtering to achieve desired deposition rate using design of experiment method"
  Vir Karan, Ashok Allamula, Peela Lasya, Daljin Jacob, Satyesh Kumar Yadav, Parasuraman Swaminathan, *Journal of Electronic Materials* (*under review*) [*Pre-print*]
- "Accelerated Solutions of Coupled Phase Field Problems Using Generative Adversarial Networks"
  Vir Karan, Maruthi Indresh, Saswata Bhattacharya, *Computational Materials Science* (*under review*) [*Pre-print*]
- "Quantification of similarity and physical awareness of microstructures generated via Generative Models"
  Sanket Thakre, **Vir Karan**, Anand K Kanjarla, *Computational Materials Science 221* (*2023): 112074* [*Full-Text*]

Conference Proceedings

- "Optimization of the deposition process parameters of DC magnetron sputtering to achieve desired deposition rate using design of experiment method", Proceedings of the International Conference of Thin Films & Nanotechnology: Knowledge, Leadership & Commercialization; **Vir Karan**, Ashok Allamula, Peela Lasya, Daljin Jacob, Satyesh Kumar Yadav, Parasuraman Swaminathan

Bachelor's Thesis

Design of Ultra-Thin-Metal Films for Opto-Electronic Applications   (**August 2022 - May 2023**)

Guide: Dr Satyesh Kumar Yadav, Materials Design Lab, IIT Madras

- Surveyed existing patents on physical vapour deposition of metals onto organic substrates to design experiments for the same
- Applied Taguchi Design of Experiments (DoE) to optimize DC Magnetron sputtering parameters for conductive Ag-films
- Studied the effect of annealing and substrate roughness on Ag-SiO2 ultra-thin films deposited using sputtering
- Identified new parameter combinations to provide both maximum and minimum deposition rates in the chosen design space

Research Experience

Studying Interface Propagation using Physics-Informed Neural Networks   (**May 2022 - September 2022**)

Guide: Dr. James D Hogan, Centre for Design of Advanced Materials, University of Alberta

- Applied Physics-Informed Neural Networks to solve interface propagation problems governed by Ginzburg-Landau equations
- Simulated microstructure evolution during stress-induced materensitic phase transformations using the developed framework
- This work was done in collaboration with the *U.S Army*; a manuscript fit for a journal article is being prepared for the same

Morphology Optimization in DP Steels using Deep Learning   (**September 2021 - May 2022**)

Guide: Dr. Anand K Kanjarla, Mechanics of Microstructures Group, IIT Madras

- Developed a deep learning framework to solve inverse problems of generating DP Steel microstructures with target properties
- This framework employed a StyleGAN2 to generate the microstructures, a Pix2Pix GAN to predict local stress fields of the microstructure and a Bayesian Optimization algorithm to locate the correct morphology with most tensile damage resistance

Quantification of awareness of GAN Generated Microstructures   (**December 2020 - March 2022**)

Guide: Dr. Anand K Kanjarla, Mechanics of Microstructures Group, IIT Madras

- Implemented a StyleGAN2-ADA to generate two-phase microstructures of 6 morphologies using only 300 training samples
- Achieved an R^2 score of 90% using a Random Forest regressor to predict the damage initiation stress of microstructures
- Statistically analysed the generated microstructures with studies using the learned latent space and damage stress predictions

Accelerated Solutions of Coupled Phase Field Problems Using GANs   (**July 2021 - February 2022**)
Guide: Dr. Saswata Bhattacharya, Computational Materials Science Group, IIT Hyderabad
o Built a Custom GAN architecture using Convolutional-LSTM layers for solving coupled PDEs, such as the phase-field equations
o Set a Benchmark MSE of 0.0002% for a non-physics informed solution to the coupled Cahn-Hilliard equations in ternary alloys
o Analyzed the efficiency, scalability & accuracy of the trained model as a replacement for conventional numerical solvers

CALPHAD-Coupled Phase Field Modelling of Al-Zn Alloys   (**May 2021 - August 2021**)
Guide: Dr. Abhik Choudhary, Materials Modelling Group, IISc Bangalore
o Used the thermodynamic properties of the Al-Zn system from the pyCALPHAD library to build the potential well
o Simulated microstructural evolution by solving the coupled phase-field PDEs numerically

Technical Skills

o **Programming Languages:** Python, C, MATLAB, JavaScript (*Fundamentals*)

o **Frameworks and Libraries:** Tensorflow, Keras, NumPy, Sci-kit Learn, Open-CV, SciPy

o **Materials Modelling:** VASP, Abaqus(*Fundamentals*), DREAM.3D, pyCALPHAD, VESTA, ParaView

o **Scientific Tools:** GNU Octave, JMP 16.0, LaTeX

Relevant Courses   G - Graduate Level Elective, c - Certified Online Course

o **Computation:** Finite Element Analysis^G — Atomistic Modelling of Materials^G — Introduction to Programming — Computational Materials Engineering Lab — Data Structures and Algorithms^c

o **Materials Science:** Thermodynamics of Materials — Transport Phenomenon — Phase Transformations — Materials in Renewable Energy Tech^G — Physics of Materials — Non-Metallic Materials

o **Data Science:** Machine Learning^c — Deep Learning ^{G}— Reinforcement Learning^G — Practical Machine Learning in TensorFlow^c — Molecular Data Science & Informatics^G

o **Experiment & Characterization:** Statistical Design and Analysis of Experiments^G — Materials Characterization — Advanced Transmission Electron Microscopy^G

o **Mathematics:** Functions of Several Variables — Probability, Statistics and Stochastic Processes — Series and Matrices — Linear Algebra for Engineers — Process Optimization^G

Co-Curricular Activities

o **Teaching Assistant** for the course *"MM3110: Computational Materials Engineering Lab"* at IIT Madras during the July-Nov 2022 term

o Attended the Canadian Society of Mechanical Engineers (CSME) 2022 at the University of Alberta, Edmonton

Extra-Curricular Activities

o **Co-Founder & Head, Behavioural Insights Club** (IIT Madras): **Founded** the first independent behavioural science club in a technical institute in India, to foster the development of a community of enthusiasts and connect the student body of IITM to experts in the field via research and industrial projects

o **Head, Shaastra**[2] **Mind Trials** (*Shaastra 2021-22, IIT Madras*): **Headed** a team of 8 to host awareness initiatives and a case-study competition on the application of Behavioural Sciences into solving pressing societal issues such as Sanitation, Road Safety, Nutrition and was responsible for managing a **budget of INR 1,00,000**

o Part of the **Editorial Team** of the MME department magazine, **ETCH**: Co-authored scientific articles on Sustainable practices in alloy design and processing, and on the Undergraduate Research culture

o **Student Mentor** (*Avanti Fellows 2019-20*): **Mentored** a student from JNV Pondicherry to prepare for the JEE Main and Advanced examinations, as part of the Avanti Fellows Pondicherry Chapter

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2. Shaastra is the annual technical fest of IIT Madras