Pranav Sudersan

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Expertise: surface science, atomic force microscopy, modelling and programming

Education

Ph.D. in Chemistry — Feb. 2019 – Jul. 2023
Johannes Gutenberg University (Max Planck Graduate Center) — *Mainz, Germany*
PhD thesis: Understanding reversible underwater adhesion in terrestrial ladybug beetles
Supervisors: Prof. Dr. Hans-Jürgen Butt, Prof. Dr. Eduard Arzt

M.Tech and B.Tech in Chemical Engineering — Jul. 2010 – Aug 2015
Indian Institute of Technology (IIT-B) — *Mumbai, India*
Masters thesis: Preparation and characterization of sugar-oil microemulsion glasses
Supervisor: Prof. Dr. Jyoti R. Seth

Work Experience

Postdoctoral Researcher — Jan. 2024 – Present
University of Murcia (UM) — *Murcia, Spain*

Doctoral Researcher — Feb. 2019 – Apr. 2023
Max Planck Institute for Polymer Research (MPIP) — *Mainz, Germany*

Project Assistant — Jul. 2018 – Oct. 2018
Institute of Chemical Technology (ICT) — *Mumbai, India*

Research Associate — Aug. 2016 – Jun. 2018
Indian Institute of Technology (IIT-B) — *Mumbai, India*

Business Data Analyst — Jul. 2015 – Jul. 2016
Hongkong and Shanghai Banking Corporation (HSBC) — *Bangalore, India*

Research Projects

Nano-scale wetting characterization using non-contact AFM | *UM, Spain* — Jam. 2024 – Present

- Detailed investigation of the effect of capillary condensation on tip-sample interaction in a dynamic AFM system was performed using simulations and experiments.
- Dynamics of the oscillating cantilever was numerically simulated to identify the conservative and dissipative interaction contributions of the condensed liquid neck.
- Interaction vs distance experiments were performed while maintaining the system at resonance with a phase-locked-loop. Such a method allows stable non-contact probing of the liquid neck via the amplitude (dissipative) and frequency shift (conservative) channels.

Surface tension measurement of micro-droplets using AFM | *MPIP, Germany* — Jan. 2022 – Apr. 2023

- Developed a new method to measure surface tension of micrometre sized liquid drops with an AFM using standard cantilevers, eliminating the need of expensive "nano-needle" shaped tips used by state-of-the-art methods.
- Polymer-brush based simple coating procedure was used to make the cantilever tip "non-stick", which allowed measurements with negligible loss of liquid.
- The capillary force interaction of a pyramid shaped tip with the liquid drop was modelled using numerical simulations and subsequently used to calculate surface tension from experimental force curves.

Mechanism of reversible underwater adhesion in ladybug beetles | *MPIP, Germany* — Feb. 2019 – Oct. 2021

- Developed a setup to perform *in-vivo* adhesion measurements of a ladybug's foot against a surface underwater.
- The role of an air-bubble trapped within the foot's hairs when underwater was systematically investigated on hydrophilic and hydrophobic functionalized glass surfaces, with and without the trapped air bubble.
- Experiments were complimented with simple modelling of the hairy foot's adhesion to conclude that the insect's oily secretion at the hair's tips plays a dominant role in its underwater adhesion via capillary forces, while the force contribution due to the trapped bubble is rather negligible.

Dynamic interfacial tension measurement of soap solutions | *ICT, India* Jul. 2018 – Oct. 2018

- Devised a simple setup to measure dynamic interfacial tension using drop-volume method.
- Efficacy of various soap formulations for cleaning oil (dirt) was evaluated by above method.

Unusual self-assembly of polyelectrolytes into micro-fibrils | *IIT-B, India* Aug. 2016 – Jun. 2018

- Self-assembly mechanism of polyethylenimine (PEI) into microfibrils was modelled by minimizing the total energy of the system in various configurations, thereby numerically simulating a phase-space.
- Positively charged PEI chains were found to counter-intuitively attract under specific conditions within this phase-space, resulting from an entropic effect by shared counterions between the PEI chains.

Preparation and characterization of sugar-oil complex glasses | *IIT-B, India* May. 2014 – Aug. 2015

- Solid-state microemulsions were synthesized using a mixture of sucrose, limonene oil and surfactant.
- The microemulsion was used later as a template to prepare interpenetrating polymer networks.

Technical Skills

Experimental: AFM, Chemical Vapour Deposition, Optical microscopy, Design/build setups, Surface functionalization

Programming: Python, LABVIEW, MATLAB, LaTeX

Software: Git, Linux, Surface Evolver, ImageJ, MS Excel/VBA

Publications

(1) **Sudersan**, **P.**; Seth, J. Method for Preparing Bi-Continuous Inter- Penetrating Polymer Network pat., 390921 (India), 2019.

(2) **Sudersan**, **P.**; Kappl, M.; Pinchasik, B.-E.; Butt, H.-J., et al. Wetting of the Tarsal Adhesive Fluid Determines Underwater Adhesion in Ladybird Beetles. *Journal of Experimental Biology* **2021**, *224*, doi: 10.1242/jeb.242852.

(3) Song, J.; Hou, Y.; **Sudersan**, **P.**; Lam, C. W. E., et al. Inhibition of Condensation-Induced Droplet Wetting by Nano-Hierarchical Surfaces. *Chemical Engineering Journal* **2023**, *460*, 141761, doi: 10.1016/j.cej.2023.141761.

(4) **Sudersan**, **P.**; Kappl, M. Mechanisms of Detachment in Fibrillar Adhesive Systems. *Journal of Theoretical Biology* **2023**, *557*, 111315, doi: 10.1016/j.jtbi.2022.111315.

(5) **Sudersan**, **P.**; Müller, M.; Hormozi, M.; Li, S., et al. Method to Measure Surface Tension of Microdroplets Using Standard AFM Cantilever Tips. *Langmuir* **2023**, *39*, 10367–10374, doi: 10.1021/acs.langmuir.3c00613.

(6) Zhou, X.; **Sudersan**, **P.**; Diaz, D.; Leibauer, B., et al. Chemically Robust Superhydrophobic Surfaces with a Self-Replenishing Nanoscale Liquid Coating. *Droplet* **2024**, *3*, e103, doi: 10.1002/dro2.103.

(7) Zhou, X.; Wang, Y.; Li, X.; **Sudersan**, **P.**, et al. Thickness of Nanoscale Poly(Dimethylsiloxane) Layers Determines the Motion of Sliding Water Drops. *Advanced Materials* **2024**, *36*, 2311470, doi: 10.1002/adma.202311470.

Miscellaneous

Softwares developed: 1) *AFM Dashboard* - An interactive Jupyter notebook to read and analyse AFM data; 2) *Buggee* - A python based GUI tool for synchronous video and text data processing for scientific analysis

Conferences: European Colloidal and Interfacial Society Conference 2024 (poster); Spanish Royal Society of Physics Biennial 2024 (oral & poster); Society of Experimental Biology Annual Conference 2021 (oral); Congress of the International Society of Biomechanics 2021 (oral)

Languages: Fluent in English, Hindi and Malayalam, A1 level in Spanish and German

GRE scores (2017): Total: 326/340, Quantitative: 170/170, Verbal: 156/170

Hobbies: Guitar/music production, DIY electronics, biking