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Notice for the PhD Viva-Voce Examination

Ms Soorya S Raj (Registration Number: 1840080), PhD scholar at the School of Sciences, CHRIST (Deemed to be University), Bangalore will defend her PhD thesis at the public viva-voce examination on Monday, 16 October 2023 at 10.30 am in Room No. 044, Ground Floor, R & D Block, CHRIST (Deemed to be University), Bengaluru - 560029.

Title of the Thesis	:	**Fabrication of Robust Wettability Gradients on Soft Surfaces through Physicochemical Modulations**
Discipline	:	**Chemistry**
External Examiner (Outside Karnataka)	:	**Dr Soney Varghese** Professor Nanomaterials & Devices Research Laboratory School of Materials Science & Engineering National Institute of Technology Calicut, Kerala
External Examiner (Within Karnataka)	:	**Dr Sajan Daniel George** Professor and Head Centre for Applied Nanosciences Department of Atomic and Molecular Physics Manipal Academy of Higher Education Manipal- 576 104 Karnataka
Supervisor	:	**Dr Vinod T P** Associate Professor Department of Chemistry School of Sciences CHRIST (Deemed to be University) Bengaluru - 560029 Karnataka

The members of the Research Advisory Committee of the Scholar, the faculty members of the Department and the School, interested experts and research scholars of all the branches of research are cordially invited to attend this open viva-voce examination.

Registrar

Place: Bengaluru
Date: 05 October 2023

ABSTRACT

The creation of robust surface gradients on soft materials is an emerging area of research in materials chemistry. Polydimethylsiloxane (PDMS), an elastomeric soft material, is widely employed in diverse research fields due to its exceptional properties including ease of processability, biocompatibility, and transparency. These properties make it an ideal choice for applications in microfluidics, soft robotics, and biomedical devices. Creating surface gradients on soft surfaces can be challenging, requiring expensive chemicals, sophisticated instrumentation, time, and complex experimental setups. This study presents simple and cost-effective methods for creating chemical (wettability) and physical (morphological) gradients on PDMS surfaces.

The methods we developed to create wettability gradients involves (i) creation of a gradient of crosslinking density on the PDMS surface by using a differential curing method and (ii) selective inhibition of normal curing using an inhibitor. Contact angle measurements confirm the successful creation of both radial and linear gradient of surface wettability using both these methods with regions of higher crosslinking density exhibiting higher hydrophobicity. We have also devised an innovative technique for fabricating morphological gradients on soft surfaces. The method makes use of differential curing and buckling instability to create hierarchical wrinkled patterns on the PDMS surface. Optical microscopy and profilometry confirm the uniformity, reproducibility, and controlled optical properties of the wrinkled surface patterns.

Gradients we prepared demonstrated excellent performance in various applications, including water collection, cell adhesion, and triboelectric charge generation. They can be utilized in microfluidics, sensors, and biomedical devices due to their structural consistency, controllable physical responses, and reproducibility of the performances. Future work can explore the potential of these methods for creating more complex surface gradients and patterns. The integration of functional materials onto the surface patterns for enhanced performance in various applications can also be achieved through these systems. Overall, this study provides simple and economical approaches for preparing surface gradients on PDMS surfaces with high reproducibility and controllability.

Keywords: *Polydimethylsiloxane, Soft surfaces, Wettability gradients, Morphological gradients, Water collection, Cell adhesion, Triboelectricity*

Publications:

1. **Soorya S Raj**, Saya Ann Suresh and Vinod T. P., "Gradients on soft surfaces," *Mapana Journal of Sciences*, 2020, Vol. 19, No. 2, 73-93, ISSN 0975-3303, https://doi.org/10.12723.
2. **Soorya S Raj**, R. M. Mathew, Y. Nair, S. T. Aruna, and Vinod T. P., "Fabrication and Applications of Wrinkled Soft Substrates: An Overview," *ChemistrySelect*, vol. 7, no. 16, 2022, doi: 10.1002/slct.202200714, Q2 journal, Impact factor – 2.307.
3. **Soorya S Raj**, D. Davis, P. Viswanathan, A. Chandrasekhar, and Vinod T. P., "Compositionally Homogeneous Soft Wrinkles on Elastomeric Substrates: Novel Fabrication Method, Water Collection from Fog, and Triboelectric Charge Generation," *Macromol. Mater. Eng.*, vol. 2200247, p. 2200247, 2022, doi: 10.1002/mame.202200247, Q1 journal, Impact factor – 4.367.