

## Fascinating Lab to Land Journey of Versatile Nanostructured Indoor Solar Cells

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In the realm of third-generation molecular light-harvesting technologies, our focus is on efficiently capturing and recycling diverse light sources, including indoor, artificial, ambient and diffused sunlight using custom engineered dye-sensitized solar cells (DSCs). DSCs stand out for their high efficiency, exceeding 40%, and their suitability for indoor use due to their lower cost, stability and ease of production.<sup>1-2</sup> Recent innovations, such as co-sensitization approach, introduction of dual-species copper-based electrolytes replacing traditional iodide systems, use of bilayer TiO<sub>2</sub>-ZnO nanostructured electrodes, have addressed recombination issues, enhancing performance of these innovative nanophotovoltaic devices under indoor and ambient lighting conditions.<sup>1-4</sup> These advancements not only improve efficiency but also promote environmentally friendly practices, positioning DSCs as a viable option to replace conventional one-time-use primary batteries for powering electronic devices, facilitating self-powered applications thereby reducing the carbon footprint.

My presentation will highlight CSIR's pursuit of self-reliance in indoor light-harvesting technologies underscored by advancements in the domain of DSCs and the fascinating lab to land transition being realized developing innovative self-powered products in my research lab at NIIST over the past decade. At NIIST, our endeavors extend to the custom design and optimization of these indoor light harvesters, utilizing tailor-made molecules, materials, and device architectures realizing efficiencies of 40% and above.<sup>1</sup> By nurturing capabilities, CSIR strives to establish a formidable position in the global indoor photovoltaic landscape, and propelling India towards self-sufficiency in emerging photovoltaic sectors.

### **References:**

- [1] Journal of Materials Chemistry A, 2024, 12, 32721-32734
- [2] Journal of Materials Chemistry A, 12, 2024, 1081-1093.
- [3] Journal of Materials Chemistry A, 11, 2023, 14748-14759.
- [4] Journal of Materials Chemistry A, 6, 2018, 22204.

### **Speaker Bio**

Dr. Suraj received his Ph.D. from Dublin City University, Ireland, and pursued postdoctoral research at Caltech and Michigan State University, USA. He joined CSIR-NIIST in 2014 and currently serves as a Senior Scientist at the Centre for Sustainable Energy Technologies (C-SET). His research focuses on the indigenous development of indoor solar cells using third-generation molecular light-harvesting technologies such as dye-sensitized and perovskite solar cells, aiming to replace one-time use primary batteries realizing self-powered gadgets. He established a state-of-the-art molecular photovoltaics lab at CSIR-NIIST and has authored over 50 publications as corresponding author in this area. Dr. Suraj is a recipient of several prestigious awards, including the Solar Challenge Award (2023), CSIR Young Scientist Award (2020), INSA Medal for Young Scientist (2020) and Kerala State Young Scientist Award (2018).