



## SCDT – FlexE Centre Webinar Series

The webinars aim to bring together researchers in Flexible Electronics and allied areas from across India (and other countries) on a single platform to promote professional interaction.

### Webinar by



### Dr. Jayaraj Nithyanandhan

Senior Principal Scientist  
Physical & Materials Chemistry Division,  
National Chemical Laboratory, Pune and  
Professor at Academy of Scientific and  
Innovative Research

on  
“Squaraine Based Organic Dyes for Dye-  
Sensitized Solar Cells”

**Date:** 11<sup>th</sup> March, 2025

**Time:** 7:30 PM to 8:30 PM

Visit [www.iitk.ac.in/scdt/webinars.html](http://www.iitk.ac.in/scdt/webinars.html)  
to access the zoom link to join the  
webinar.

The event will be chaired by  
**Dr. Anirban Mondal**  
Indian Institute of Technology  
Gandhinagar

### Abstract of the Webinar

In dye-sensitized solar cells (DSSCs), dye-TiO<sub>2</sub>/electrolyte interface plays an important role in modulating the charge injection, charge recombination and dye regeneration processes. Aggregation of organic dyes on the TiO<sub>2</sub> surface leads to self-quenching of photo-excited states which hampers the charge injection process which in turn affects the device performance. On the other hand, it helps to broaden the absorption profile of light absorbing sensitizers due to the formation of either H or J type aggregates. Hence controlling the aggregation dyes on TiO<sub>2</sub> for enhancing the light harvesting efficiency and passivating the for surface reducing the charge recombination process is desired for achieving high J<sub>SC</sub> and V<sub>OC</sub> of the DSSC devices, respectively. To test this hypothesis, a series of alkyl group wrapped squaraine dyes were designed and synthesized, and fabricated the DSSC devices with I<sup>-</sup>/I<sup>3-</sup> electrolytes. Incident photon-to-current conversion efficiency profile showed the contribution of aggregated structures for the photocurrent generation. Furthermore, integrating the electronic effects by means of introducing electron donating and withdrawing groups, and pi-conjugation within polymethine frame offers modulated HOMO energy levels of the dyes, a set of visible far-red and NIR active dyes, respectively. Visible light active squaraine dyes with more positive HOMO energy levels showed compatibility with copper electrolyte with the device V<sub>OC</sub> of 1 V. Results on the DSSC device performances of both visible and far-red active squaraine dyes will be discussed.

### Information about the speaker

Dr. Jayaraj Nithyanandhan is a Senior Principal Scientist in the Physical, Chemistry Division at CSIR National Chemical Laboratory (NCL), Pune. He is also a Professor at the Academy of Scientific and Innovative Research. He completed his PhD at Indian Institute of Science, Bangalore followed by a stint as post-doctoral Associate at the University of Miami, Coral Gables, Florida. He then joined CSIR NCL in 2012 where he has been working since. His area of research interest include organic synthesis, organic photochemistry, supramolecular chemistry, photo responsive materials and dye-sensitized solar cells.