# CONDENSED MATTER SPECIAL SEMINAR

## Wed 2 August 2017 at 2.15pm

## "Recent Progress on Organic & Polymeric Semiconducting Materials for Practically Useful Dye-Sensitized Solar Cells "

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Dye-sensitized solar cells (DSSCs) have aroused intense interest and been regarded as one of the most prospective solar cells, due to low-cost, flexibility, simple device fabrication and high conversion efficiency under weak light, in comparison to the conventional photovoltaic devices. According to PV Installation Market Share' projection, DSSCs will have been significantly increasing in demand in a near future. Very recently, G2E in Swiss and G24i in UK including Korean and Japan companies have demonstrated commercial and prototyped components based on DSSC technology employing liquid electrolytes. A state of the art DSSC based on porphyrin-based SCs employing cobalt-based electrolyte as well as Ru-complex-based SCs employing iodide electrolyte has exceeded the conversion efficiency of over 13% and 11.9%, respectively. However, the unit costs, long-term device stability and power conversion efficiency must be further improved for real-life applications.

Therefore, we demonstrated that new the alkylated thieno[3,2-b]indole (TI) moiety-based D-π-A sensitizers and D–π–A structured Zn(II)–porphyrin sensitizers based on the structural modification of SM315 as a world champion dye for efficient retardation of charge recombination and fast dye regeneration were newly designed and synthesized, since the molecular combination of each fragment in D–π–A organic sensitizers can be a pivotal factor for achieving the higher PCEs and an innovative strategy for strengthening the drawbacks of the π-bridge. The device with new porphyrin sensitizers exhibited the higher PCE than those of the devices with SM315. To further improve the maximum efficiency of the DSSCs, the first parallel-connected (PC) tandem DSSCs employing cobalt electrolyte in the top and bottom cells were demonstrated and an extremely high efficiency of 14.64% was achieved, which is currently the highest reported value for organic-based tandem SCs. Also, to improve the long-term device stability, triblock copolymer-based quasi-solid state DSSCs with significantly improved long-term device stability exhibited an overall photovoltaic conversion efficiency(PCE) of 10.32%, which is higher than a liquid electrolyte-based DSSC with a value of 9.98%. Furthermore, we have searched low-cost, scalable metal-free counter electrodes (CEs) based on carbon-based nanomaterials and edge-functionalized graphene nanoplatelets with improved fill factor and low-cost for alternative to expensive and noble Pt metal CEs, those factors of which limit large scale production and thus prohibit the practical application of DSSCs. **In this presentation**, new strategy on materials paradigm for low-cost, long-term stable, highly efficient dye-sensitized solar cells will be described to give right answers in overcoming the limitation of the existing technology for the practical use.

**References:**

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**Host: Prof Robin Nicholas**
**Audrey Wood Seminar Room, Clarendon Laboratory**