“Efficiency enhancement of solar cells via spectral conversion”

Lecturer:

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Abstract:

The two major losses are encountered in a single-junction photovoltaic (PV) devices, that of: i) sub-band gap transmission of low energy photons; and ii) lattice thermalisation losses associated with high energy photons. The traditional solution to this problem is to develop tandem solar cells, however this has only been successful with two material systems so far, amorphous silicon alloys and III-V semiconductors. This talk explores the application of passive luminescent layers to realise up-conversion (UC) and down-conversion (DC). DC results in the generation of more than one lower energy photon being generated per incident high-energy photon, while UC generates one photon with higher energy for every two or more sub-band gap photons absorbed. The addition of either of these layers to a silicon solar cell could enhance raise the upper efficiency limit by up to 10% absolute. Our work relies on both organic and inorganic luminescent materials and exploits the potential of photonic crystal structures as well. Furthermore, for organic materials, this talk explores the possibility of controlling the direction of light emission by integrating organic chromaphores into novel crystalline host materials. One solar technology that would benefit from controlling the direction of light emission is the luminescent solar concentrator (LSC).