Master Degree Project in Applied Physics, SCI School for HT19/VT20

Title: Nanoparticle-polymer nanocomposites for photovoltaics

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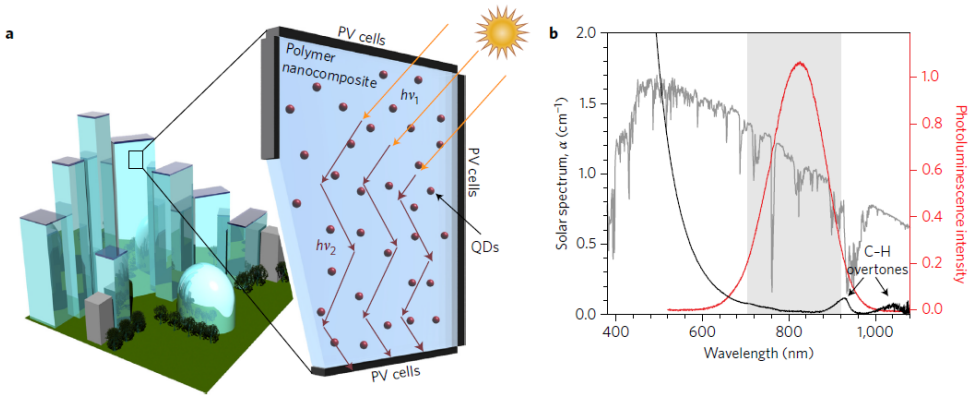
Background: To achieve the desired goal of the so-called 'nearly zero energy building' decreed by the EU, building-integrated photovoltaics (BIPV) is gaining consensus as a renewable energy technology for producing electricity at the point of use. The BIPV concept does not necessarily need to be limited to roofs and facades, but can be also extended to windows. Although the inherent window transparency should be maintained, even a partial conversion of the sunlight to electrical energy can generate sizeable power quantities where large surface areas are involved. Luminescent solar concentrators (LSCs) provide a simple and cost-effective strategy for harvesting sunlight using windows to generate electricity. An LSC typically consists of a single transparent surface (e.g., glass or plastic) that is coated with emissive chromophores, such as organic dyes or quantum dots (QDs), as shown in Figure below. Incident sunlight (direct or diffused) is absorbed by the chromophores and re-emitted at a longer wavelength[1-2]. The emitted light then propagates to the edges of the LSC by total internal reflection in polymer waveguide and is converted into electricity by PV cells installed along the perimeter of the LSC.

Project objective: In this project, indirect bandgap Si QDs will be employed as chromophores to construct LSC devices, and off-stoichiometric thiol-ene (OSTE) will be used as polymer waveguide. Competitively of Si QDs in the polymer matrix plays an important role to keep transparent of the LSC device. Therefore, the goal of this project is to find the optimized capping ligand for Si QDs and tune the polarity of thio- and ene- monomers, for fabricating polymer-Si nanocrystal nanocomposite with high photoluminescence quantum yield, high loading of Si QDs and good transparency.

Project plan: The primary tasks in this full-time Master project include:

- Synthesis of Si QDs with different capping ligand
- Fabrication of Si QDs/OSTE nanocomposite
- Photoluminescence quantum yield measurement of Si QDs, and Si QDs/OSTE nanocomposite

Applications: Please contact Associate Professor Dr. Ilya Sychugov, ilyas@kth.se; project can be started at any time Fall/Winter 2019/2020



1. Meinardi, F.; Brovelli, S., *Nat. Photonics* **2017**, 11, 177.
2. Marinins A.; Sychugov I., *ACS Appl. Mater. Interfaces* **2017**, 9, 30267.