Enhanced Light Harvesting Efficiency in Solar Cells Coupled to Photonic Crystals

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We show experimental evidence that light harvesting efficiency (optical absorption) of a dye-sensitised solar cell, and therefore its photogenerated current efficiency, is greatly enhanced due to resonant modes that appear when the absorbing electrode is coupled to a photonic crystal. Our experimental incident photon to current conversion efficiencies (IPCE) are enhanced above a 100% for certain frequency ranges with respect to that of standard solar cells used as reference, being the overall efficiency improved by a 30%. Different configurations in which a photonic crystal can be implemented in such devices are modelled and their absorbance compared. The effect of the finite size and the composition of the crystal on the amplification is also discussed, new perspectives for photonic crystal based photovoltaics being proposed.[1]

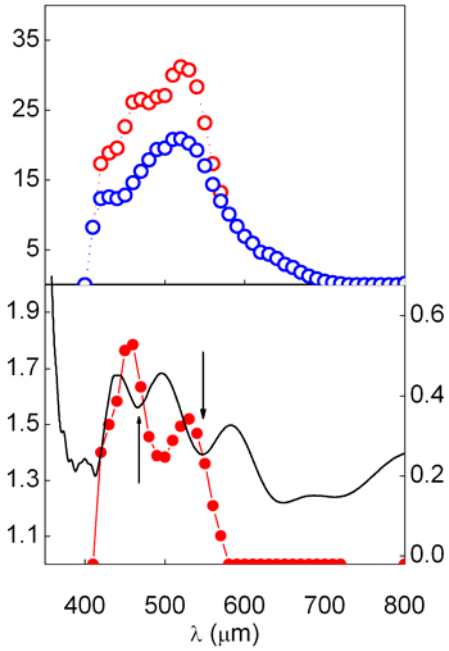

Figure 1. (Top) Incident photon to current conversion efficiency of a standard dye-sensitised solar cell (red open circles) and that of the same cell coupled to a photonic crystal (blue open circles). (Bottom) The corresponding enhancement factor of the IPCE (red circles) along with the reflectance of the cell (solid line) showing the spectral coincidence of the resonant modes (pointed with arrows) and the enhancement maxima.

[1] A. Mihi, F.J. López-Alcaraz, H. Míguez, Appl. Phys. Lett. (2006)