Novel (nano)materials applied to solar energy conversion

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In this presentation we will discuss how the nanoscience and the nanotechnology can help to design more efficient and cheap materials for solar energy conversion. Nanomaterials can be successfully applied as active layers, interfaces or contacts in solar cells and light emitting diodes (LEDs); they can also promote the generation of solar fuels through photocatalytic processes using only solar energy.

The use of nanomaterials has allowed the development of two important photovoltaic technologies (also called emerging solar cells): *dye sensitized solar cells* (DSSC) with efficiencies approaching 14 % and *organic (or plastic) solar cells* with efficiencies approaching 17 %. More recently, perovskite materials have been extensively investigated as thin films for photovoltaics achieving efficiencies of 24%, surpassing polycrystalline silicon devices. Perovskite colloidal nanoparticles have been also applied in LEDs, lasers and photodetectors with sucess. Perovskite nanoparticles have their emission spectra spanning from the blue to the red, and such property can be easily tuned by adjusting size (quantum confinement) and composition of the nanocrystals.

It is interesting to observe that several types of (nano)materials used in solar cells are also employed to generate oxygen and hydrogen from water or to reduce carbon dioxide in solar fuels (methanol, formaldehyde, etc).

The Laboratório de Nanotecnologia e Energia Solar at Unicamp has explored the use of the (nano)materials in solar energy conversion. This is a very challenging, but also a very promising and exciting area of research on renewable energy. In this presentation we will present our more recent results where novel (nano)materials (pristine or sometimes combined with other materials, as graphene) can be successfully applied to increase the efficiency of solar energy conversion in solar cells, LEDs and photocatalysis.

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