Seminar

Znanstvenog centra izvrsnosti
QuantiXLie i Fizičkog odsjeka

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Photonic Crystals Solar Cells:
Prospects for World Record Efficiencies

Photonic crystals are widely known for their light-trapping capabilities. This is often associated with the occurrence of a photonic band gap or other suppression in the electromagnetic density of states [1,2]. This enables guiding of light on an optical micro-chip and unprecedented forms of **strong-coupling between light and matter**. In the past, practical applications of these effects have focused on information technology. More recently, an important opportunity has emerged in the area of energy technology. This arises from light-trapping in the higher bands of a photonic crystal, where the electromagnetic density of states is enhanced rather than suppressed. This enables unprecedented strong absorption of sunlight in a thin-film material with weak intrinsic absorption [3-10].

We describe designs of **photonic crystal solar cells** consisting of less than **ten micron thickness of silicon** that enable the absorption of 98% of all available sunlight in the wavelength range from 300 nm to 1100 nm. These 3D photonic crystals exhibit an enhanced electromagnetic density of states, consisting of slow group velocity modes, in which the flow of energy is transverse to the depth of a thin film of material. The ability to absorb nearly all sunlight, using light-trapping, in a flexible 10 micron sheet of silicon, enables considerable reduction of carrier Auger recombination losses in the bulk. Coupled with recent advances in surface passivation near electrical contacts, it is possible to **reach a power conversion efficiency of 30%, well above the current world record for any silicon solar cell**.

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Ponedjeljak, 18. 6. 2018., 15:15 sati

Fizički odsjek, prostorija F-201

Znanstveni centar izvrsnosti
za kvantne i kompleksne sustave te
reprezentacije Liejevih algebri

Projekt KK.01.1.1.01.0004

Projekt je sufinancirala Europska unija iz Europskog fonda za regionalni razvoj. Sadržaj ovog seminara isključiva je odgovornost Prirodoslovno-matematičkog fakulteta Sveučilišta u Zagrebu te ne predstavlja nužno stajalište Europske unije.

Europska unija
Zajedno do fondova EU

EUROPSKI STRUKTURNI I INVESTICIJSKI FONDOVI

Operativni program KONKURENTNOST I KOHEZIJA

EUROPSKA UNIJA
Europski fond za regionalni razvoj