Embedded plasmonic nanoparticles in high refractive index TiOx matrix for photovoltaics applications - DTU Orbit (09/12/2018)

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Resume: More frequently high refractive index dielectric matrix are used in thin film photovoltaics as transporting layers with good optical proprieties. Doping such matrix with plasmonic resonant scatterers is a promising way to further increase energy conversion efficiencies by trapping incoming light in ultrathin solar cells. Colloidal plasmonic oligomers are obtained following a cost-effective selfassembly strategy and incorporated in organic based cells produced using spincoating techniques in ambient air conditions. An interesting increase is observed of both external quantum efficiency (EQE) and short-circuit current for solar cells loaded with plasmonic oligomers compared with reference organic cells. Theoretical calculations demonstrate that the wavelength dependent EQE enhancement is a resonant process due to the increased scattering efficiency in plasmonic antennas allowed by a chemically controlled 1 nm nanogap. The nanogap antennas are linked at a controlled distance of a few nanometers by Dithiothreitol molecules. The spacing molecules ensure a minimum distance that plays a fundamental role in the formation of intensity hot spots in the nanogap as well as large and redshifted scattering peaks. This OPV device, realized in ambient air condition, exhibited an efficiency 14% higher than the reference one showing a relevant enhancement in the red part of the EQE measurements.

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