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Simulated maps of efficiency for dye-sensitized and organic solar cells

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Dye-Sensitized Solar Cells (DSCs) and Organic Solar Cells (OSCs) represent very promising photovoltaic technologies able to reach power conversion efficiencies of 15% and 11% respectively. A DSC is essentially an electrochemical cell based on a thin nanoporous titanium dioxide layer (10-15 μm) where a monolayer of molecular dye (generally Ru-based) is chemisorbed. This hybrid organic-inorganic structure is dip in a liquid electrolyte where a redox couple is present. The whole system is sandwiched between two conductive glasses and encapsulated by a sealant. On the other hand the active layer of an OPV is a blend of two mixed organic materials, a donor and an acceptor semiconductor, conventionally P3HT and PCBM, respectively. The active blend is closed between two contacts with different work functions to collect free charge carriers. We have developed a model based on finite element to describe both devices within drift-diffusion and Poisson equations. The application of finite element method allows to solve the model over a general domain in 1D, 2D and 3D. This opens interesting new perspectives for the analysis and optimization of DSCs and OSCs. The model is implemented within the multiscale Tiber CAD simulation tool. The fine tuning of the light absorption, transport parameters and the geometry of the active layer, allows us to define a consistent parameterization of the simulator which is then used as a predictive tool to calculate maps of efficiency for different working conditions and different fabrication geometries (Tandem configuration).

Biography

Desiree Gentilini has completed her PhD in Electrical Engineering from University of Tor Vergata in Rome, where she is doing her Postdoctoral studies. Her work is focused on simulation of organic and hybrid solar cells.

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