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Molecular strategies towards efficient small-molecule photovoltaic materials

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Bulk-heterojunction organic solar cell (BHJ-OSC) utilizes a nanostructured electron donor and electron acceptor blended film to capture and convert solar photons into electrons. Recently, much attention has been focused on non-fullerene organic acceptors, which are used as acceptor materials to replace the traditional fullerene acceptor materials. The exciton-type photon-to-electron conversion efficiencies such as exciton generation and charge separation and transport are largely dependent on the material absorption, frontier molecular orbitals and film-morphology. In this report, I will show our results on the molecular strategies towards efficient small-molecule photovoltaic materials. The results include: (1) The photovoltaic properties from the twisted perylene-dimide dimer acceptors, (2) the photovoltaic properties from BODIPy based small molecule donor and acceptor, and (3) the photovoltaic properties from Diketopyrrolopyrrole (DPP) and quinoidal methyl-dioxycano-pyridine based small molecule donors, in particular, the effects of the end units capping on the DPP main chain and the influence from the anchoring groups terminated on the flexible alkyl chains.

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Nanocrystalline hydroxyapatite-phosphonate composites

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Two new hybrid compounds apatite-phosphonate are prepared by hydrothermal method. For that, vinyl or methyl phosphonic acid variable quantity is added during apatite synthesis. X-ray diagrams confirmed the apatite structure conservation and permitted to evaluate crystallite sizes. The values are in nanometric range (25 - 2.5 nm). IR and Raman spectroscopy showed apatite characteristic bands and also phosphonate bands. ³¹P MAS-NMR spectra present the apatite isotropic signal and new signals attributed to phosphonate organic phosphor. ¹³C MAS-NMR reveals vinyl or methyl characteristic signals. Thermo gravimetric analysis shows a weight loss between 200 and 600°C attributed to the organic moiety decomposition. Differential thermal analysis (DTA) confirms the exothermic effect. The value of this loss increases with the increase of grafting, in good agreement with the results of the ¹³C chemical analysis. Specific area measurements show obtaining porous hybrid apatite-phosphonate compounds whose porosity is controlled by the rate and the nature of the graft. The observation by Transmission Electron Microscopy (TEM) and Atomic-force microscopy (AFM) powders of these new materials shows that the crystallite size is in the nanometer scale and decreases with the amount of graft added during synthesis.

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