PR-17. INTERFACIAL DOPING OF ORGANIC SEMICONDUCTORS ACCESSIBLED BY ANIONIC p-DOPANT CN6-$CP^{\bullet -}K^{+}$

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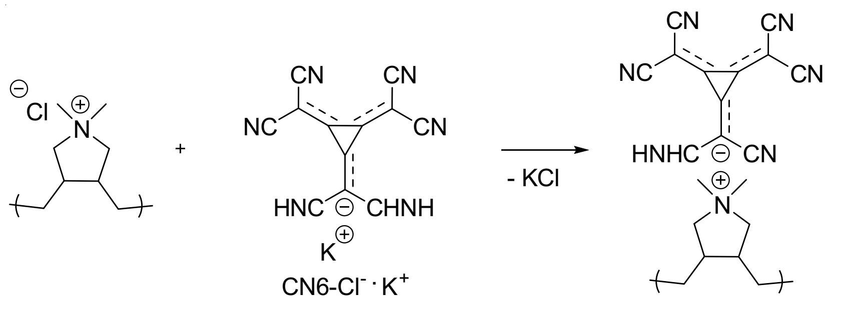
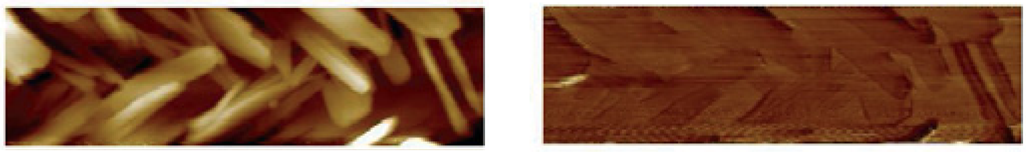
The dopant CN6-$CP^{\bullet -}K^{+}$ with a dual functionality was utilized for achieving of the 2D (interfacial) doping of organic semiconductor layers. Unlike to the method for sequential processing of doped films, which leads to the 3D (bulk) doping, the placement of the polycation ultra-thin separation layer between the semiconductor and the dopant as well as the use of highly polar water-soluble dopant (immiscible with the semiconductor) prevents penetration of the dopant into the semiconductor enabling purely interfacial doping. 2D-doped films exhibit more than order of magnitude higher conductivity than that of 3D doped P3HT&CN6-$CP^{\bullet -}NBu_4^{+}$ films prepared by traditional mixed solvent method (for P3HT films having the same thickness). Remarkably, 2 nm-thick P3HT film (this thickness is comparable to the molecular P3HT height in the edge-on orientation), exhibits conductivity of about 13 S/cm which is one of the highest conductivity values among observed even in much thicker doped P3HT films. The interfacial doping was earlier reported for single-crystalline small-molecule semiconductor systems. Our P3HT/PDADMAC/CN6-$CP^{\bullet -}K^{+}$ system exhibits the state-of-the-art square resistance of 27 kΩ [(μm/μm) = 22,5 × 1,2 kΩ], despite of a significant disorder generally observed in polymers. As such, the developed layer-by-layer procedure is the efficient method for achieving of highly conductive films. The superior efficiency of the interfacial doping was explained in terms of favoured morphology and increased mobility of charge carriers spatially-separated from the dopant phase. The demonstrated method for immobilization of dopants and engineering of interfaces may find new applications such as in multilayered devices with alternating doped and undoped (and oppositely-doped) areas with sharp interfaces and minimized inter-diffusion of the components.





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