Modified copper-based metal-organic frameworks as novel photoanode material

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Metal Organic Frameworks (MOFs) are highly porous, crystalline, and well-ordered organic-inorganic hybrid channel structures. Their physical and electronic properties, such as surface areas, band gaps, and photoactivities, can be fine-tuned simply by changing the organic linker ligand or the metal center or by incorporating molecules into channels of MOFs or by post-synthetic modification methods. Linkers of some MOFs can act as light-harvesting antennae and most of them absorb light from the visible region. Hence, those kinds of MOFs are suitable as sensitizer materials of the Dye-sensitized Solar Cells (DSCs) and their light absorption capacity can further be improved by post-synthetic modifications. In this project, a novel composite of MOF-199 and TiO_2 nanoparticles (MOF-199 coated TiO_2) were designed and synthesized. This novel material was characterized by using PXRD, FT-IR, SEM, and Mott-Schottky analysis and it was used as a new photoanodic material of DSCs. EIS investigation showed that the MOF-199 coated TiO_2 structure is essential to reduce the charge-transfer resistance of the TiO_2/ MOF/ electrolyte interface. The MOF-based solar cell devices were fabricated by using the screen-printing method and optimization was done through layer thickness, the ratio of MOF:TiO_2, and the type of electrolyte. These novel photoanode-based SCs exhibited 0.004% efficiency (η) and the conductivity and light absorption capacity were improved by adsorption of Rhodamine G6 to that structure. It leads to significant improvement in cell efficiency (η = 0.022%) with *Voc* = 0. 44 V, *Jsc* = 0.1 mA cm^{-2}, and FF = 0.42.

Keywords: Metal-organic frameworks, Sensitizer, Post-synthetic modification, TiO_2