Virus-Templated and Highly Interconnected Electrodes for Dye-Sensitized Solar Cells

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Among renewable solid-state photovoltaics, dye sensitized solar cells (DSSCs) has received extensive interest due to their high energy conversion efficiency and inexpensive production cost. One of the most important issues for enhancing the cell efficiency od DSSCs is to design the advanced photoelectrode structure of TiO2 nanoparticles (NPs), which can affect the surface coverage of sensitizer adsorption and the pathway for electron transport. In this study, one dimensional (1D) and soft biomaterial of M13 virus was hybridized with TiO2 NPs and used to construct a template for the highly interconnected electrode. After sintering process, M13 viruses left porous channel structures that were highly bifurcated and interconnected inside TiO2 NPs, which could provide capabilities of increased surface sites for a dye adsorption as well as efficient paths for direct electron transport to TCO. In addition, we presented the optimized photoelectrode structure through manipulating the concentration of virus-mixed paste and the chain conformation of viruses.