Virus-Templated Synthesis of Three-Dimensional Networked TiO_2 Photoelectrodes for Water Splitting

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With the growing interest in nanostructured materials, virus-templated approach to synthesize these structures has received considerable attention. It has the special advantages of obtaining novel architectures, precise controllability over particle shape and size, flexibility and economic viability. M13 Virus, one of the most well-known viruses, is a notable template due to its one-dimensional hairy shape which can be utilized for the synthesis of nanowires. In this study, by utilizing the genetically modified virus for the selective binding of titanium precursor, we presented virus-templated synthesis of TiO_2 photoelectrodes for water splitting. After sintering process, M13 viruses left three-dimensional scaffolds of highly interconnected TiO_2 nanoparticles inside the photoelectrodes. In this structure, TiO_2 nanoparticles could provide increased number of surface sites for light absorption as well as efficient paths for charge transport. In addition, we explored the effect of size control of TiO_2 nanoparticles by varying the charge density and chain conformation of the M13 virus.