MESOPOROUS TITANIA WITH ANATASE FRAMEWORK SYNTHESIZED USING POLYPHENOLIC STRUCTURE-DIRECTING AGENT

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Crystalline mesoporous titania (TiO_2) has attracted considerable attention due to its high-potential applications in sensors, dye-sensitized solar cells, lithium-ion battery technologies, photocatalysis, and heterogeneous catalysis.[1, 2] The versatile applicability of TiO_2 is attributed to its high surface area, large pore volume, and uniform mesopores, which promote a facile diffusion of reactants and products as well as an increased accessibility of active sites through the mesopores.

In the present work, crystalline anatase TiO_2 with a nanosponge-like morphology was solvothermally synthesized using a random copolymer of 4-vinylphenol and methylmethacrylate as a structure-directing agent. In this polymer-directed crystallization process,[3] the polymer equipped with phenolic groups strongly bound to the titania precursor leading to the formation of the crystalline nanosponge materials (**Fig. 1**). The pores in the TiO_2 nanosponge became fully accessible after the removal of the polymer through calcination. The resulting TiO_2 nanosponge possessed mesopores with a narrow distribution of diameters, which could be systematically controlled by changing the synthetic gel composition, calcination atmosphere (*e.g.* O_2 or ozone), and temperature. Furthermore, the synthesis domain for highly mesoporous TiO_2 nanosponge was established over a wide range of synthetic gel compositions. The mesoporous TiO_2 supporting Pt catalyst (1 wt.%) exhibited high dispersion of Pt nanoparticles (averagely 1.4 nm) on the nanosponge surface (**Fig. 2**). In alcohol-to-aldehyde partial oxidation reaction, Pt/TiO_2 nanosponge exhibits a higher conversion of benzyl alcohol (50%, with 100% selectivity towards benzaldehyde) in comparison to Pt/commercial-TiO_2 catalyst (33% conversion, with 100% selectivity).

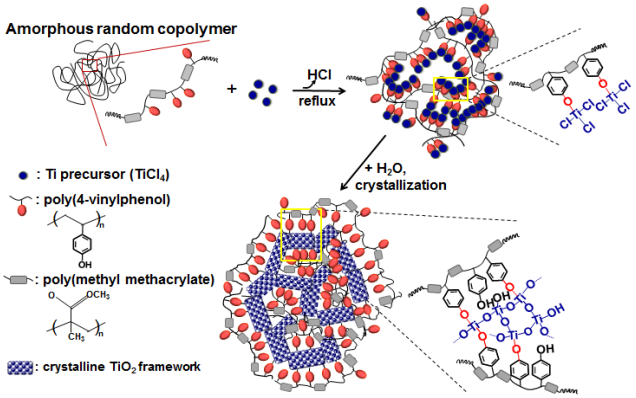

Fig. 1 Schematic illustration of the formation of TiO_2 nanosponage.

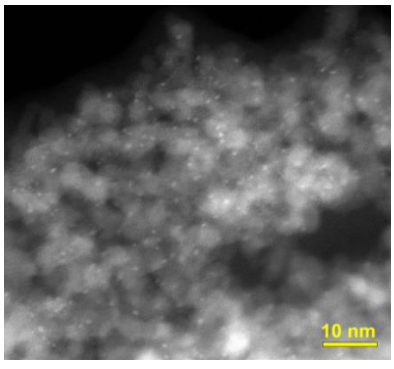

Fig. 2 STEM image of 1 wt% Pt/TiO_2 nanosponge.

References:

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