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Supramolecular self-assembly synthesis of ordered mesoporous TiO_2 from industrial TiOSO_4 solution and its photocatalytic activities

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The ordered mesoporous titanium dioxide precursor was prepared via supramolecular induced self-assembly synthesis route by controlling the hydrolysis conditions of industrial TiOSO_4 solution and pH value of the reacting system to adjust the agglomeration, condensation and self-assembly rate of template and inorganic titanium source, using composite surfactant template (CTAB and P123) as the structure-directing agents and industrial low concentration TiOSO_4 solution as titanium source. The ordered mesoporous titania was obtained after template removal and calcination, with hexagonal mesoporous structure, S_{BET} of $237.3 \text{ m}^2/\text{g}$, average pore diameter of 3.41 nm and anatase phase. And it showed high photocatalytic activity for methylene blue with the discoloration rate of 99.94%. The as-prepared materials were characterized by XRD, HRTEM, SAED and nitrogen adsorption and desorption method. The hydrated colloid particles of TiO_2 and composite template interacted through static force and hydrogen bond on the interface, cooperated to form the mesoporous structure, and the mesopore formation mechanism belonged to a synergistic mechanism.

Fig. 1 Small angle (a) and wide angle (b) XRD patterns of the precursor and mesoporous titania

Fig.2 HRTEM photograph (a) and SAED pattern (b) of the precursor (A) and mesoporous titania (B)

Fig.3 Nitrogen isotherms (a) and pore size distribution (b) of the precursor (A) and mesoporous titania (B)

Fig.5 Photocatalytic activities for Methylene Blue

Fig.4 The schematic diagram of the interface interaction for mesoporous titania