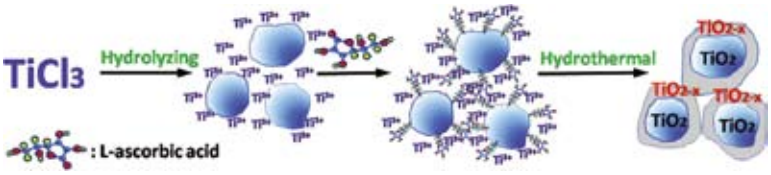
Technology

An Alternative Approach to Fabricating Defective TiO_{2-x} Nanocrystal Photocatalysts

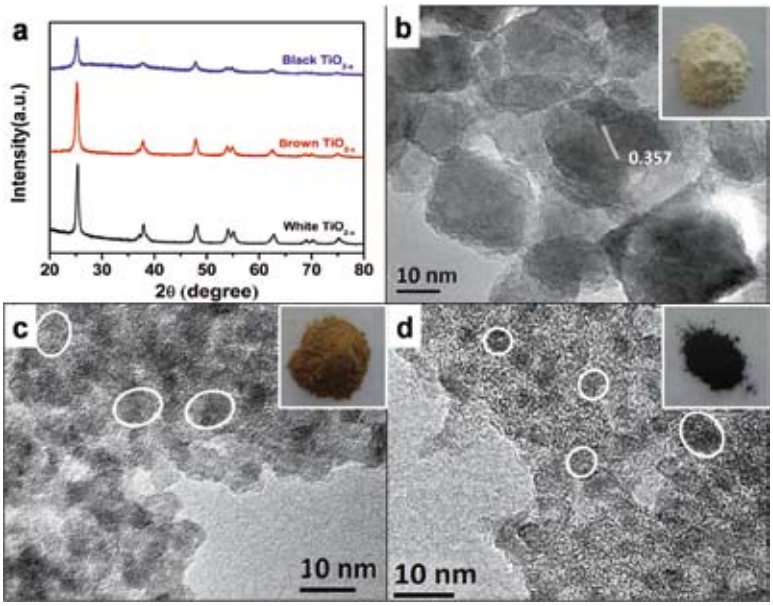
TiO_2 is one of extensively studied photocatalytic materials for its practical applications in many important fields such as photocatalytic hydrogen evolution, environmental remediation and solar energy conversion. In recent years, the black TiO_2 attracts great attention as TiO_2 nanoparticles with defective, amorphous layer displayed excellent visible-light activity and stability in photocatalytic hydrogen generation.

Prof. WANG Chuanyi and his colleagues from the Xinjiang Technical Institute of Physics and Chemistry under the Chinese Academy of Sciences employed a facile hydrothermal approach to produce defective TiO_{2-x} nanocrystals with high surface area and tailoring band gap using Ti(III)-salt as a precursor, and *L*-ascorbic acid as reductant and structure direction agent.

Researchers mixed $TiCl_3$ and *L*-ascorbic aqueous solution, and heated the mixture at 180°C in a 100 mL Teflonlined stainless steel autoclave for 12 h to get the black TiO_{2-x} nanocrystals. The obtained black TiO_{2-x} nanocrystals exhibited a high surface area and excellent visible light absorption. By testing with photocatalytic degradation of MB(20 mg/L) and phenol (10 mg/L), and hydrogen generation under a 300W Xenon with UV cut-off filter (λ>420 nm), the black TiO_{2-x} nanocrystals shows extremely high efficiency.



Schematic diagram for the formation of defective TiO_{2-x} nanocrystals.



XRD patterns (a), TEM images(white TiO_{2-x}(b), brown TiO_{2-x}(c), black TiO_{2-x}(d)), of the defective TiO_{2-x} nanocrystals.

"We try to develop an economical and environmentally friendly method to produce black and visible-light response TiO_2 photocatalyst. Then, we found the black TiO_2 particles obtained have small crystal size and extremely high surface area," explained assistant professor ZHU Yunqing from the institute. "In other work, we combined the black TiO_2 nanocrytals with copper, which also showed excellent activity in CO_2 photoreduction."

Their study, published in *Scientific Reports*, provided an alternative approach for fabricating defective TiO_{2-x} nanocrystal photocatalysts with tailoring bandgap for environmental remediation and solar fuel generation.

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