Hollow-Structured Semiconductor Oxides for Photocatalytic Environmental Applications

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Hollow materials generally show better performance than their solid counterparts thus they are excellent candidates for various applications in the fields of energy, environment, health, or sensing. However, their fabrication can be challenging therefore scientific community attends to their selective synthesis.

Semiconductor hollow structures are of growing interest in the field of photocatalysis, too. These objects are interesting not just because of their low apparent density but also their unique optical properties. For the synthesis of either carbon-metal oxide composites or hollow semiconductor structures, nanometer sized carbon spheres (CS) were prepared by mild hydrothermal treatment of ordinary table sugar (sucrose). The size of these spheres can be controlled by the parameters of the hydrothermal treatment (e.g. time and pH). CSs were successfully coated with TiO_2 and ZnO *via* either sol-gel method or atomic layer deposition[1]. Subsequently, burning out the carbon core templates resulted in hollow metal oxide nanospheres. The unique hollow sphere morphology proved to enhance the photocatalytic activity (six times) as well as TOC removal efficiency (twelve times) compared to the sample which was prepared by the same method without the CSs[2].

Au and Pt nanoparticles were also deposited onto the surface of titanium dioxide hollow structures to further increase the photocatalytic activity. The modification of titanium dioxide by noble metal nanoparticles can result in the inhibition of electron-hole recombination and the extension of excitability to the visible light region due to surface plasmon resonance.

References:

[1] https://www.nature.com/articles/s41598-017-04090-0

[2] https://www.sciencedirect.com/science/article/pii/S0920586116307921