Investigation of Core-Shell Nanocatalyst AU@Cds for Ammonia Synthesis

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A team of researchers from Xinjiang University has prepared Au@CDs photocatalyst with a core-shell structure by combining coal-based carbon dots (CDs) with gold sol. With its high photocatalytic activity in the synthesis and visible-light photocatalytic N2/H2O to ammonia, this has far-reaching significance for the further development of coal resources to prepare high-performance materials.

Synthesis and visible-light photocatalytic N2/H2O to ammonia at atmospheric pressure and room temperature is considered to be the most ideal ammonia synthesis technology. However, fixing N2 to NH3 under mild conditions remains a major challenge.

In this study, coal-based carbon dots (CDs) were prepared by H2O2 oxidation method using cheap and ubiquitous coal as the carbon source. Then the gold sol was connected to CDs to obtain a core-shell structure photocatalyst Au@CDs by sodium borohydride (NaBH4) reduction method. While characterizing the material structure, the photocatalytic N2/H2O to ammonia performance of Au@CDs was investigated.

The results show that the prepared Au@CDs has higher photocatalytic activity for photocatalytic N2/H2O to ammonia, the yield of Au@CDs photocatalytic N2/H2O to ammonia about 3.5-fold higher than that of bare CDs. Using N2-TPD, UV-Visible, EPR, and electrochemical tests to study the photoelectric properties of the prepared photocatalysts.

The photocatalyst Au@CDs prepared by CDs coated with precious metal Au not only improves the carrier performance of the catalyst under visible light but also inhibits the recombination of photocatalyst hole pair, promote the charge transfer ability, and make the photocatalyst and hold move smoothly to the photocatalyst surface. At the same time, it also improves the adsorption and dissociation ability of N2 on the catalyst surface, thus promoting the photocatalytic N2/H2P ammonia synthesis reaction.

This work will contribute to the better design of carbon nanoparticle-coated metal-type photocatalytic materials, which will be of far-reaching significance for the further development of coal resources to prepare high-performance materials.

The Xinjiang University team is currently exploring the preparation of more suitable photocatalysts to improve photocatalytic nitrogen fixation for ammonia synthesis. For more insight into the research described, readers are invited to access the paper on NANO.

Synthesis and visible-light photocatalytic N2/H2O to ammonia of Au@CDs core-shell nanocatalyst.