TiO2 Hollow Shell Around Gold Nanoparticles- A More Efficient Photocatalyst

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Objective: Synthesize gold nanoparticles (AuNPs) surrounded by a titania (TiO2) hollow shell to serve as a more efficient photocatalyst. Method: The AuNPs were prepared by mixing the gold precursor with trisodium citrate. Polyvinylpyrrolidone was coated on the AuNPs to prevent them from aggregating. The AuNPs were then coated with a layer of silica. The titania was coated over the silica, and the silica was etched using sodium hydroxide which created a hollow space around the AuNPs. Hydrochloric acid was added so that the TiO2 hollow shell would remain intact during calcination. TiO2 hollow shells without a gold core were synthesized and compared with gold and titania (Au@TiO2) in the degradation of the organic dye Rhodamine B (RhB). The 3 samples analyzed were RhB blank sample, RhB with only TiO2 hollow shell, and RhB with Au@TiO2 catalyst. The UV-visible absorption spectrophotometer was used to compare breakdown rates of the RhB in each of the 3 samples. Results: The RhB decomposed the slowest with no catalyst. The breakdown of RhB was enhanced with the titania alone, but was fastest with the Au@TiO2 photocatalyst. Conclusion: Au@TiO2 is a more efficient photocatalyst. The basis of titania's photocatalytic activity is the formation of electron-hole pairs. However, the electron-hole pairs are destroyed by the process of recombination. The gold nanoparticle attached to the titania hollow shell serves as an electron sink, delaying the process of recombination. Thus, the electron-hole pairs are available for a longer time to participate in redox reactions. The enhanced photocatalytic activity of Au@TiO2 can be used in many reactions including the splitting of water. It is a possible solution for a cleaner source of hydrogen gas.

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