Effects of Morphology and Illumination on the Catalytic Properties of Gold Nanoparticles

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Gold nanospheres and nanoplates were synthesized by aggregation of gold seeds to determine how the difference in their morphologies and the presence of visible light would affect the rate at which they catalyze reduction reactions. The catalytic properties are caused by Localized Surface Plasmon Resonance (LSPR), which causes electron clouds to oscillate when plasmonic substances such as gold are exposed to electromagnetic radiation, such as visible light. LSPR has been shown to have differing effects on nanoparticles with different morphologies, but this effect on catalysis has not been reported on. The reduction of 4-nitrophenol (4-NP) into 4-aminophenol (4-AP) was used to demonstrate this property. This reaction was chosen for this experiment because it has been previously used in nanoparticle based experiments where rate of reduction was being analyzed and its progress is easily monitored by use of spectrophotometry. It was suggested by analysis and comparison of the UV-visible spectra of the reaction as it proceeded that nanospheres catalyzed the reduction of 4-NP into 4-AP much more effectively. However, the nanoplates showed an increase of almost 300% in the reaction rate under the light compared to the dark, whereas the nanospheres showed only minimal improvement under light. The results support the idea that nanospheres are more effective catalysts than nanoplates, perhaps due to their increased electron density.

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