Alloy Nanoparticles of Plasmonic Metal and Catalytic Active Metal as Visible light Photocatalysts for Organic Syntheses

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The visible light photocatalysts for organic synthesis under mild reaction conditions is long sought and a rarely achieved aim in modern catalyst chemistry. With these photocatalysts, we are able to drive useful organic synthesis processes under mild conditions. Nanostructures of gold (Au), silver (Ag) and copper (Cu) intensively absorb visible light due to the Localized Surface Plasmon Resonance effect and known as plasmonic metals. These nanoparticles can channel the absorbed light energy to the reactant, inducing reaction under moderate conditions. However, the number of reactions can be catalyzed by photocatalysts of plasmonic metal nanoparticles is limited. To address this problem, we developed photocatalysts of alloy nanoparticles for driving various chemical reactions with visible light.

The alloy photocatalysts strongly absorb light and exhibit high activity at near ambient temperatures for many reactions, including several cross-coupling reactions, oxidative addition of benzylamine, hydroamination, oxidative esterification of aliphatic alcohols using molecular oxygen as a benign oxidant. We found that alloying small amounts of copper into gold nanoparticles can alter the reaction pathway of catalytic reduction of nitroaromatics: nitroaromatics is transformed directly to anilines under visible-light irradiation at ambient temperature in a highly selective manner. Interestingly, light irradiation can alter the product selectivity of a reaction catalyzed by an alloy nanoparticle catalyst: the main product under light is different from that in the dark.

The knowledge acquired could be useful in the development of new heterogeneous photocatalysts for the production of important chemicals.

Biographical Statement of speaker:

B. Sc., Inner Mongolia University, China (1982); M.Sc., Nankai University, 1986; Ph. D, University of Antwerp, Belgium, 1994.

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