New Insights into Photocatalytic Alkyne Hydroamination Reaction with Au-Co Alloy Nanoparticles

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Abstract:

Photocatalysis is an intriguing phenomenon in the realm of green chemical science, as it combines the efficiency of catalysis with the use of light energy. In this study, we developed highly efficient alloy nanoparticles (NPs) of Au and Co (Au:Co 2:1 wt % ratio) supported on ZrO2 that catalyze hydroamination of alkyne reaction at ambient temperature under visible light irradiation with super eminent activity (99 % conversion and 95 % product selectivity). Due to the strong electrostatic repulsion between pi-electrons cloud of the alkyne and N lone pair of electrons in aniline, this reaction has a high activation barrier. When Au-Co alloy NPs strongly absorb visible light, the energetic conduction electrons of Au migrate to Co sites at the surface of alloy NP due to the charge redistribution between the two metals. The energetic particle surface is favorable for the activation of the reaction and exhibits higher reaction conversions than that of monometallic counter parts. More interestingly, it is worthwhile to notice that, on Au-Co alloy surface, visible light illumination lead to different product selectivity compared with the reaction without light: imine (cross-coupling product) of alkyne and aniline is dominant in photocatalytic reaction while the homo-coupling of alkyne is the major product in dark reactions. However, when Au NPs are used as catalysts, similar product selectivity is achieved in both dark and light with much lower conversion rates. These evidences demonstrated that the reaction pathway of hydroamination of alkyne is tunable by switching on and off the light on Au-Co alloy surface.

Biographical Statement of speaker:

Erandi Prangige is currently a PhD student at Science and Engineering Faculty, Queensland University of Technology, Australia under the guidance of Prof Huaiyong Zhu. Her research interests include finding new insights into visible-light photocatalysts for fine organic synthesis, with noble metal nanoparticles and their alloy nanoparticles.