The collaboration research for the Dual Graduate School between VNU and JAIST

[Title of collaboration research]

Preparation of structure controlled metal nanoparticles and their application to catalysts

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http://www.jaist.ac.jp/ms/labs/kyokugen/Miyake.lab/new/html/frame.htm

[Other references]

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We have established convenient preparation methods of monodispersed and size controlled metal nanoparticles (less than 4 nm), such as Pt, Pd, and Au, by the reduction of metal ion in liquid phase in the presence of organic protective agents. We applied size controlled metal nanoparticles as catalyst to produce carbon nanotubes with controlled diameter (*Carbon*, 2005, *Appl. Catal., A*. 2006). We focus our attention on protective agents to design noble functions. We succeed to arrange small Au nanoparticles with less than 2 nm in 2D by the aid of weak π-π interaction between the protective agents with bisimidazol pyridine groups (*J. Amer. Chem. Soc.*, 2000). The distance between Au nanoprartilces could be controlled by the size of the protective agents. Presence of NaI hinder and unaffect the grouth of (100) and (111) faces of Pt nanoparticles, respectively, resulting in formation of cubic Pt nanoparticles consisting of only (100) face on surface (*Chem. Lett.*, 2005). We have also succeeded to prepare tetrahedral Pt nanoparticles consisting of (111) face under similar reaction conditions (by the reduction with H_2 in the presence of PAA) without NaI. The Pt nano-cube may be highly potential material as active catalysts for oxygen reduction in fuel cells, since Pt (100) face is known to be more active than Pt (111) face. Recently, we take into consideration of solvent polarity, which may affect functionality of organic protective agents. When discotic liquid-crystalline compound was used as a protective agent of Au nanoparticles, we found that Au nanoparticles arrange in 1D at a specific solvent polarity adjusted by the solvent composition, indicating the significant effect of solvent polarity on the degree of π-π interaction between the protective agents with liquid-crystalline properties (*Chem. Commun*., 2006； inside cover, highlights article). We have also report a convenient method to prepare single-crystalline Pt nanowires with high aspect ratio of ca. 2.0 nm diameter by sophisticated and precise control of Pt(0) nuclei and their growth in a fixed direction with specific facets by the plausible adsorption of DMF under controlled solvent polarity (*Chem. Commun*, 2006； inside cover, highlights article). Thus, we believe that our nanoparticles with precisely controlled size, shape, and arrangement open to realize new catalysts with high performace.