This presentation includes following two topics:

1) Porous metal-organic frameworks (MOFs) as platforms for functional applications

There has been a rapid development in metal-organic frameworks (MOFs), especially porous MOFs, due to their high potential for diverse applications in the past decade. Recently, we have successfully synthesized a number of new porous MOFs and found their new applications as catalysts, as templates for nanoporous carbon synthesis, and as supports for metal nanoparticles as well as for large molecule separation. Novel porous metal-organic frameworks have been synthesized, which presents a stable catalytic activity for the oxidation of CO to CO₂. Porous carbon has been synthesized by using MOF-5 or ZIF-8 as a template and the resultant carbon displayed a high specific surface area and hydrogen uptake as well as excellent electrochemical properties as an electrode material for electric double-layered capacitor (EDLC). Metal nanoparticles (NPs) have been deposited to MOFs, which exhibit excellent catalytic performances in various reactions. Mesoporous MOFs have been successfully synthesized, which can be used for separating large dye molecules. Crystalline MOF nanosheets have been fabricated via top-down delamination from bulk crystals of a layered MOF, which exhibit remarkable amine intercalation property and reversible amine exchangeability.

2) Metal nanoparticle-catalyzed hydrogen generation from liquid-phase chemical hydrogen storage materials

Hydrogen, H₂, is a globally accepted clean fuel. The use of hydrogen fuel cells in vehicles or in portable electronic devices requires lightweight H₂ storage or “on-board” hydrogen generation, for which the most important are safety, ease to control and fast kinetics of the hydrogen release along with a high hydrogen content. Here we report excellent liquid-phase hydrogen generation systems suitable for use as portable hydrogen sources, which are based on metal nanoparticle-catalyzed hydrolysis of ammonia borane (NH₃BH₃), complete decomposition of hydrous borane (H₂NNH₂) and decomposition of formic acid. NH₃BH₃ dissolves in water to form a stable solution, to which the addition of a catalytic amount of suitable metal catalysts leads to rigorous release of hydrogen gas with an H₂ to NH₃BH₃ ratio up to 3.0. Metal and metal-alloy nanoparticles (NPs) effectively catalyze the decomposition of hydrous hydrazine to selectively produce hydrogen under ambient reaction conditions. Gold-palladium alloy nanoparticles immobilized to mesoporous MOFs and monometallic gold nanoparticles encapsulated in amine-functionalized silica nanospheres exhibit high performances for catalytic decomposition of formic acid to H₂ and CO₂, the latter showing strong metal-molecular support interaction (SMMSI), an unusual effect from the molecular functionalization of metal/support. In addition, we have developed a novel direct ammonia borane fuel cell (DABFC) by combining the anodic oxidation of ammonia borane (H⁺ to H₃) and the cathodic reduction of O₂.

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National Institute of Advanced Industrial Science and Technology (AIST) and Kobe University
Nanostructured materials and their functional applications

CBC SEMINAR ANNOUNCEMENT

Date: 5th July 2013 (Friday)
Time: 3:00pm – 4:30pm
Venue: NTU SPMS LT 5
Host: Asst Professor Zhao Yanli