# Material Chemistry

The materials chemistry have obtained the high achievements that covered a broaden areas of research topics in 2009. In the activity report, we have invited four outstanding users from numerous important active users to write highlights of their excellent performance. Profs. Yu Wang, Soofin Cheng and Ru-Shi Liu are from National Taiwan University and Prof. Jen Ray Chang from National Chung Cheng University.

The light induced excited spin state trapping (LIESST) phenomenon was commonly observed on Fe(II) spin crossover complexes at extremely low temperature using laser light with appropriate wavelength as a pumping source. Prof. Yu Wang's research team focus on the structure at the metastable (LIESST) state of Fe(II) spin crossover complexes. It may provide significant information concerning the structural changes during the excitation and the relaxation processes, which then lead to the changes in electronic configuration of Fe(II) ion directly. Two polymorphs of spin crossover mononuclear Fe(II) complexes, trans-$Fe(tzpy)_2(NCS)_2$, were isolated and structurally characterized by X-ray diffraction, X-ray absorption, infra-red absorption and magnetic measurement at the LIESST state. Polymorph A undergoes a gradual spin transition from a paramagnetic high spin state ($^5T_2$, S = 2, HS-1) above 200K to a diamagnetic low spin state ($^1A_1$, S = 0, LS-1) below 120 K, while polymorph B possesses an abrupt spin transition with $T_{1/2}$ at 102 K. Molecular and crystal structures of polymorph A at HS-1 and LS-1 are studied at 300 and 40 K respectively.

The influence of anion follows the Hofmeister series commonly encountered in macromolecular and biological systems like proteins, DNA and lipids may be predicted. It is extended to the materials chemistry of mesostructured silica by probing the anion-exchange induced phase transformations by Prof. Soofin Cheng. Her research team studied the early stage phase transitions of mesostructured silica synthesized using cetyltriethylammonium (CTEA) ion as the pore-directing agent in acidic environments. It was ready to have interfacial anions exchanged during the variation in interfacial environment. In the pore structure and the architecture of silica framework was observed when the interfacial anions were exchanged by anions of higher salting-in power. The resultant phase transformation was always toward pore structures of lower curvature.

Prof. R. S. Liu has investigated the magnetic properties and nanostructures of $CoPt_3$ wires arrays that were fabricated by electrodeposition using a porous alumina template. Co-Pt alloy films exhibit strong perpendicular magnetic anisotropy and high chemical stability. The alloying process of the magnetic nanomaterial $CoPt_3$ exhibits such magnetic properties as high magnetic anisotropy and magneto-optic Kerr effects. Comprehensive structural characterizations of bimetallic nanomaterials and their phase transformation processes are crucial. A thermally induced phase transition of $CoPt_3$ nanowires to ordered $L1_2$ $CoPt_3$ through a “cluster-in-cluster” intermediate state via inter-diffusion was identified by XAS.

Sulfur poisoning is a crucial problem in petroleum chemical and oil industries. To maintain the required level of sulfur to avoid deactivation of noble-metal catalysts in commercial operation is the urgent and important issue. Prof. J. R. Chang demonstrated a novel method to prepare Pd clusters on $TiO_2$ grafted $SiO_2$ via impregnation with palladium (II) acetate followed by air-calcination and hydrogen-reduction. The results, which characterized by FT-IR, EXAFS and XRD, indicated that layer-like $TiO_2$ clusters formed on $SiO_2$ helps anchor palladium oxides during air-calcination. This anchoring leads to a formation of relatively small Pd clusters having less electronic density. Prof. Chang concluded that the superior catalytic performance for $Pd/TiO_2$-$SiO_2$ could arise from the decrease of the affinity of Pd for $H_2S$ and the increase of hydrogen reducibility for $PdS_2$.