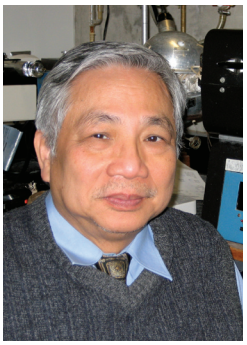

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Physical Organic Chemistry and Industrial Catalysis

Research Interests

Heterogeneous catalysis, petrochemical processes (cracking, isomerization, aromatization). Nano-technology applied to catalysis: nano-structured materials (zeolites, silica/alumina nanoboxes), used as catalysts and catalyst supports. Conversion of (cellulosic) biomass into biofuels and biochemicals.

Our main objective is to develop new nano-structured materials that can be used as solid catalysts or catalyst supports for reactions of industrial interest (petrochemical industry, biomass conversion). Two main properties are sought for our catalysts: multifunctional (catalytically active) surfaces capable of combining several reaction steps in one single step, and of providing a high product selectivity. The latter aspect is of utmost importance because it helps eliminate the formation of unwanted by-products (for a "green" process). To achieve such high selective conversion these two key factors have to be mastered: an optimum configuration of active sites (for best adsorption, on-site reaction and desorption) and favourable kinetics of diffusion of reactant (or product) molecules through a suitable catalyst nano-structure. In short, we try to reproduce the behaviour of enzymes (selective binding, constrained access) for our hybrid catalysts. Two industrial processes have been recently developed in our laboratory: the TCC (ThermoCatalytic Cracking) process which selectively produces ethylene, propylene, butadiene (precursors of several plastics, synthetic fibers and rubbers) from heavy oils, and the "Le Van Mao" process which produces "octane or cetane" boosters for gasoline or diesel (biofuels) from cellulosic biomass, and also commodity chemicals.

Selected Publications

N. Al-Yassir and R. Le Van Mao, "Catalysts for the Thermal Catalytic Cracking (TCC) process: Interactions between the yttria in yttria-doped alumina aerogel and the mono-oxide MoO_3, CeO_2, and bi-oxide MoO_3-CeO_2 species", Applied Catalysis A: General 332 (2007) 273-288.

R. Le Van Mao, L.Lu, N.T. Vu, Q. Zhao, H.T. Yang and N. Al-Yassir, "Silica nanoboxes from alumina-rich zeolites: thermal and chemical stability of the monomodal and bimodal materials", Catalysis Letters, 114 (2007) 129-134.

R. Le Van Mao, N. Al-Yassir, L.Lu, N.T. Vu and A. Fortier, "Novel method for the study of surface acidity in zeolites and other nano-porous materials using a pH-meter equipped with an ion-selective electrode", Catalysis Letters, 112 (1-2) (2006) 13-18.

R. Le Van Mao, N.T. Vu, N. Al-Yassir, N. Francois and J. Monnier, "The Thermocatalytic Cracking process for the production of light olefins and transportation fuels from gas oils ", Topics in Catalysis, 37, (2006)107-112.