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► 366 Colburn Laboratory

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Born in Tokyo, Japan, Ted Oyama received a B.S. in chemistry and a B.S. in engineering and applied science (double major) from Yale University and a Ph.D. in chemical engineering from Stanford University in 1981. He then joined Catalytica Associates, Inc. as a research engineer/project leader until joining the faculty of Clarkson University as associate professor in 1988. Prof. Oyama joined Virginia Tech in 1993 and is now the Fred W. Bull Professor of Chemical Engineering. A world leader in heterogeneous catalysis and inorganic membranes research, he serves on the editorial board for the *Journal of Natural Gas Chemistry*, the *Journal of Catalysis*, and the *Emirates Journal of Engineering* received the prestigious Humboldt Research Award from the Alexander Humboldt Foundation of Germany in 2008. In addition to being an editor of the *Journal of Catalysis*, he is also a member of the American Association for the Advancement of Science, American Chemical Society, Chemical Society of Japan, American Institute of Chemical Engineers, and the International Union of Pure and Applied Chemistry.

### “New Catalysts for Hydroprocessing: Transition Metal Phosphides”

Transition metal phosphides are a class of robust metallic substances which have promising activity for hydrotreating. These materials have ideal properties for catalysis; they are physically strong and chemically stable, and inexpensive to prepare and regenerate. The materials are synthesized by a simple procedure involving temperature-programmed reduction of phosphate precursors. The catalytic activity of the phosphides for dibenzothiophene HDS and quinoline HDN at realistic conditions (643 K and 3.1 MPa) followed the order:  $\text{Fe}_2\text{P} < \text{CoP} < \text{MoP} < \text{WP} < \text{Ni}_2\text{P}$ .

The high activity of  $\text{Ni}_2\text{P}/\text{SiO}_2$  has led to extensive studies of its activity. Studies of the effect of dispersion and characterization by extended X-ray absorption fine structure (EXAFS) allow determination of the structural parameters for the supported  $\text{Ni}_2\text{P}$  phase. The  $\text{Ni}_2\text{P}$  structure has two types of sites: Ni(1) sites with tetrahedral four-fold coordination and Ni(2) sites with square pyramidal five-fold coordination. It is found that the Ni(II) sites are more numerous on the more active and more highly dispersed samples, indicating that they are the active sites in the nickel phosphide phase. Studies with  $\text{Ni}_2\text{P}$  single crystals exposing (0001) and (10  $\bar{1}0$ ) faces give support for the higher activity of the square pyramidal sites.

A kinetic method is described to determine the role of adsorbed intermediates in heterogeneous reaction mechanisms. The method, denoted as analysis of coverage under transient conditions (ACT), involves comparing the time response of a spectroscopically-observed species in an inert gas and a reactive gas to differentiate between adsorption-desorption processes and reaction. The ACT method has potential as it can be used with any type of spectroscopy, as long as the surface coverage can be calibrated. The method is applied in kinetic studies of thiophene hydrodesulfurization (HDS) on supported nickel phosphide ( $\text{Ni}_2\text{P}$ ) catalysts.