Academic Lecture

The first 10 years of fundamental research on Cu/SSZ-13 selective catalytic reduction catalysts: key contributions from PNNL

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报告简介：

Catalyst design Cu/SSZ-13 selective catalytic reduction (SCR) has been commercialized for NOx (NO and NO2) abatement in diesel engine exhausts since about 2009. PNNL has been one of the first non-industrial institutions to conduct laboratory work to understand the nature of the active sites, reaction mechanisms, durability, and refinement of this important catalyst. In 2010, PNNL published the first open-literature paper addressing the improved activity and stability of Cu/SSZ-13 as compared to other zeolite-based SCR catalysts. Regarding the nature of the active sites, the PNNL team first proposed, based on spectroscopic investigations, that there are two distinct active Cu(II) species in this catalyst. Based on reaction kinetics and theoretical simulations, PNNL scientists first proposed that a "dual site" redox mechanism occurs for low-temperature standard SCR. In attempting to provide rational catalyst design principles for our industrial partners, PNNL scientists systematically investigated effects of catalyst composition (i.e., Si/Al and Cu/Al ratios), catalyst particle size, accelerated hydrothermal aging conditions, and cationic additives. Based on these parameters, in particular the distinct stability difference of the two active Cu(II) sites, PNNL scientists are now able to provide rational design suggestions based entirely on atomic-level fundamental understandings of this catalyst, rather than on trial-and-error. During the first decade of Cu/SSZ-13 SCR catalyst research, the PNNL team of scientists have published approximately 30 open-literature articles addressing various aspects of this catalyst. The work of PNNL scientists has been highly regarded in SCR research both in the US and internationally.

报告人简介：

Dr. Feng Gao is a Staff Scientist in the Catalysis Science Group within the Physical Sciences Division at the Pacific Northwest National Laboratory (PNNL). He also belongs to the Institute for Integrated Catalysis (IIC) at PNNL. Dr. Gao's research interests are in surface chemistry and heterogeneous catalysis; in particular the understanding of structure-function relationships on well-defined catalytic systems using a variety of spectroscopic techniques and reaction kinetics. In 2000 he joined Prof. Wilfred T. Tysoe's group at the University of Wisconsin-Milwaukee studying Surface Science, and received a Ph.D. degree in Physical Chemistry in 2004. He stayed in the same group for 3 years as a Research Associate working on chemisorption/reaction and vinyl acetate synthesis on model catalysts. He then joined Prof. D. Wayne Goodman's group at Texas A&M University as a Research Associate in 2007, working on pressure-dependent kinetics and IR spectroscopy for CO oxidation and CO/NO reactions on model noble metal and alloy surfaces. He then worked for 2 years at Washington State University as a Research Staff before joining PNNL in 2011. Dr. Gao is currently leading 3 research projects associated with selective catalytic reduction (SCR) of NOx using state-of-the-art zeolite-based catalysts.