536e Novel Mesoporous Niobium Oxide and Mixed Nb-Based Oxides for Oxidative Dehydrogenation and Ammoxidation of Propane

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Ordered mesoporous mixed metal oxides obtained using surfactant arrays or block copolymers and displaying tunable surface chemistries are attractive as high surface area catalysts for selective (amm)oxidation of lower alkanes. Despite the success of the self-assembly techniques employing surfactant arrays and block copolymers for simple oxides, e.g. SiO_2, they are yet to be established as comprehensive methods of introducing desired bulk and surface structures, chemical compositions and porosities in multicomponent mixed metal oxide catalysts.

In this study we investigated novel self-assembly concepts employing surfactant arrays and block copolymers for tuning the structures as well as the surface and bulk compositions of recently discovered multicomponent V-Mo-M-O (M= Nb, Te, Sb) catalysts, which have a remarkable ability to transform propane to acrylonitrile (ACN), a top 50 chemical in the US. The catalytic propane ammoxidation to ACN is of growing interest to the petroleum and petrochemical industries because it represents a shift in technology from petroleum-based alkene feedstocks to abundant, lower cost and environmentally friendly natural gas-based alkanes.

In this work, a thermally stable ordered mesoporous Nb_2O_5 was synthesized by a neutral templating pathway in nonaqueous medium followed by a hydrothermal treatment, and subsequent calcination to remove the template. Nonionic block copolymer (P123) and anhydrous niobium chloride were used as the template and inorganic source, respectively. The hydrothermal treatment further enhanced the surface areas and pore volumes of the ordered mesoporous niobia. Ordered mesoporous Nb-rich V-Mo-Nb-(Te)-O oxides were successfully synthesized by evaporation-induced self-assembly (EISA). These materials displayed good thermal stability up to ~500oC and promising catalytic properties in propane oxidative dehydrogenation (ODH) and ammoxidation. The comparison of structural, compositional and catalytic characteristics of these novel oxides with those reported in the catalysis literature for the bulk and supported metal oxides possessing similar chemical compositions will be presented. The results obtained indicated that EISA of ordered mesoporous mixed metal oxides is a promising approach for molecular engineering of novel mixed metal oxide catalysts for selective (amm)oxidation of lower alkanes.