Green Oxidation of Diethylamine to Diethylhydroxylamine *via* Ti Encapsulated in Bilayer Si and Its Kinetics

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Abstract

A novel eco-friendly and thermostable catalytic material Ti-Si@Si with Ti clusters doped in double Si layers was successfully synthesized including core Ti-Si preparation and an epitaxial growth of regular SiO_2 shell and analyzed *via* XRD, FTIR, UV-Vis DRS, N_2 sorption, SEM, and TEM to explore its texture characteristics. Furthermore, the oxidation of diethylamine to diethylhydroxylamine using H_2O_2 as a green oxidant was used as a probe reaction to evaluate its catalytic activity and reaction kinetics. The characterization and activity evaluation results show that SiO_2 shell introduction increases the specific surface area, pore volume, and pore size of Ti-Si; Ti-Si@Si exhibits good catalytic activity in diethylamine oxidation with good diethylamine conversion and diethylhydroxylamine selectivity, and no significant decrease of catalytic activity in repeated cycles is detected due to the active Ti species encapsulated in double Si layers. Kinetics study indicates that activity energy of diethylamine to diethylhydroxylamine is 32.194 $kJ \cdot mol^{-1}$ higher than that of diethylhydroxylamine deep oxidation, suggesting that diethylhydroxylamine deep oxidation is more prone to occur than diethylamine to diethylhydroxylamine.

Keywords

Double Si Layer, Diethylamine, Green Catalytic Oxidation, Kinetics