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Adsorption and Oxidative Desorption of Acetaldehyde over Mesoporous $Fe_xO_yH_z/Al_2O_3$

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Supporting Information

ABSTRACT: $Fe_xO_yH_z$ nanostructures were incorporated into commercially available and highly porous alumina using the temperature-regulated chemical vapor deposition method with ferrocene as an Fe precursor and subsequent annealing. All processes were conducted under ambient pressure conditions without using any high-vacuum equipment. The entire internal micro- and mesopores of the Al_2O_3 substrate with a bead diameter of ~2 mm were evenly decorated with $Fe_xO_yH_z$ nanoparticles. The $Fe_xO_yH_z/Al_2O_3$ structures showed substantially high activity for acetaldehyde oxidation. Most importantly, $Fe_xO_yH_z/Al_2O_3$ with a high surface area (~200 m^2/g) and abundant mesopores was found to uptake a large amount of acetaldehyde at room temperature, and subsequent thermal regeneration of $Fe_xO_yH_z/Al_2O_3$ in air resulted in the emission of CO_2 with only a negligibly small amount of acetaldehyde because $Fe_xO_yH_z$ nanoparticles can catalyze total oxidation of adsorbed acetaldehyde during the thermal treatment. Increase in the humidity of the atmosphere decreased the amount of acetaldehyde adsorbed on the surface due to the competitive adsorption of acetaldehyde and water molecules, although the adsorptive removal of acetaldehyde and total oxidative regeneration were verified under a broad range of humidity conditions (0−70%). Combinatory use of room-temperature adsorption and catalytic oxidation of adsorbed volatile organic compounds using $Fe_xO_yH_z/Al_2O_3$ can be of potential application in indoor and outdoor pollution treatments.