Halogen poisoning effect of Pt-TiO2 for formaldehyde catalytic oxidation performance at room temperature

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Abstract

Catalytic decomposition of formaldehyde (HCHO) at room temperature is an important method for HCHO removal. Pt-based catalysts are the optimal catalyst for HCHO decomposition at room temperature. However, the stability of this catalyst remains unexplored. In this study, Pt-TiO2 (Pt-P25) catalysts with and without adsorbed halogen ions (including F-, Cl-, Br-, and I-) were prepared through impregnation and ion modification. Pt-TiO2 samples with adsorbed halogen ions exhibited reduced catalytic activity for formaldehyde decomposition at room temperature compared with the Pt-TiO2 sample; the catalytic activity followed the order of F-Pt-P25, Cl-Pt-P25, Br-Pt-P25, and I-Pt-P25. Characterization results (including XRD, TEM, HRTEM, BET, XPS, and metal dispersion) showed that the adsorbed halogen ions can poison Pt nanoparticles (NPs), thereby reducing the HCHO oxidation activity of Pt-TiO2. The poison mechanism is due to the strong adsorption of halogen ions on the surface of Pt NPs. The adsorbed ions form coordination bonds with surface Pt atoms by transferring surplus electrons into the unoccupied 5d orbit of the Pt atom, thereby inhibiting oxygen adsorption and activation of the Pt NP surface. Moreover, deactivation rate increases with increasing diameter of halogen ions. This study provides new insights into the fabrication of high-performance Pt-based catalysts for indoor air purification. (C) 2015 Elsevier B.V. All rights reserved.

Keywords

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