Low temperature reduction of N_2O with H_2 over silica-supported Cu- based Pt catalysts : Role of Cu and Pt and their redox chemistry

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This study has been devoted to the role of Cu and Pt in silica-supported bimetallic systems for the selective reduction of N2O by H2 at very low temperatures, such as 110oC. A 1.2% Pt/SiO2 catalyst consisted of Pt nanoparticles with an average size of 1.2 nm. This particle size increased to about 5.0 ~ 6.0 nm after addition of 0.5 ~ 8.5% Cu to the Pt sample. All Cu species in bimetallic catalysts were present in the form of alloy-like CuPt; that is, metallic copper was not detected. The presence of Cu yielded a dramatic enhancement in deN2O activity in the reduction at 110oC, depending strongly on Cu loadings. In an independent experiment with a sample of 4.44% Cu/SiO2 at 110oC, this catalyst had zero activity after 0.5 h on stream. These results suggest that the chemisorbed O atoms on Cu sites in Cu-Pt catalysts during the reduction of N2O by H2 could be readily removed even at 110oC, by activated H atoms spilt from the Pt surfaces thereby generating clean Cu sites on which N2O desiccated again. This proposal was consistent with TPR and TPD measurements with SiO2-supported Pt and Cu-Pt catalysts.