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Effect of Al^{3+}/clay ratio on C_3H_6-SCR over iron catalysts supported on aluminum pillared montmorillonite (FE-AL-PILC)

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Iron based catalysts supported on aluminum pillared montmorillonite (Fe-Al-PILC) were prepared. The methods including XRD, H_2-TPR, Py-FTIR, Uv-Vis spectroscopy, ICP, N_2 adsorption-desorption, etc. were used to characterize the basic physical and chemical properties of the catalysts. The characteristics of selective catalytic reduction of NO by propylene on the catalyst surface were studied experimentally in a fixed-bed reactor, and the effect of the Al^{3+}/clay ratios on the physicochemical properties of the catalyst and the SCR-C_3H_6 was investigated. The results show that 9Fe/Al-PILC has higher SCR-C_3H_6 denitrification performance, e.g., 100% of NO conversion to N_2 was tested over 400°C. The Al^{3+}/clay ratio plays more important role on NO conversion than the calcination temperature of the carrier. According to the Al^{3+}/clay ratios, the order of catalytic activity is 9Fe/Al-PILC-10>9Fe/Al-PILC-20>9Fe/Al-PILC-5>9Fe/clay>9Fe/Al-PILC-40. Al^{3+} increased the specific surface area of the montmorillonite dramatically, and the catalyst had micropores and mesoporous structures. When the $Al3^{+}$/clay ratio was 10 mmol/g of the pillared montmorillonite had the best physicochemical property. In the Fe/Al-PILC catalysts, the iron oxides are highly dispersed on the surface of the support. H_2-TPR shows that the reduction of Fe_2O_3 phase determines the SCR activity of the catalyst. With the increase of Al^{3+}/clay ratio, the reducing temperature of the reducing process Fe_3O_4→Fe gradually increases. UV-Vis results showed that Al^{3+} increased the oligomer FexOy, and the activity of the catalyst was positively correlated with the oligomer FexOy. Py-IR results showed that both Lewis acid and Bronsted acid were favorable for the selective catalytic reduction of NO. The 9Fe/Al-PILC-10 catalyst had the best activity, which was related to its higher Brønsted acid content.

Biography

Yaxin Su has received his PhD in Power Engineering and Thermophysics with a focus on combustion from Zhejiang University, China, in 2000. He worked in the Department of Chemical Engineering, University of Mississippi, USA as a Visiting Professor during 2006-2007. He is currently a Professor in the School of Environmental Science and Engineering, Donghua University, China. He has been involved in heat transfer, gas-solid suspension flow and separation, thermo-chemical conversion of solid fuels, such as pyrolysis and combustion of coal, biomass and waste sludge, pollutant emission control, such as NOx reduction, CO_2 capture, etc. He has published three academic books and two textbooks, more than 100 journal articles and 50 international conference papers.

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