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Preparation and Catalytic Performance of Ce-Y-Palygorskite Catalysts for NO Decomposition

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Keywords: Palygorskite, Catalyst Preparation, Catalytic Performance, NO

Abstract. Ce-Y-palygorskite catalysts were prepared by chemical blending method. The effect of preparation conditions on catalytic performance of Ce-Y-palygorskite catalyst for NO decomposition was investigated in a fixed bed flow reactor. The characteristics of the Ce-Y-palygorskite catalysts were studied by X-ray diffraction (XRD) and Fourier transform infrared spectroscopy (FT-IR). The obtained results provided substantial evidence that the catalysts preparation conditions would have strong effect on the catalytic activity for NO decomposition. The Ce-Y-palygorskite catalyst prepared under the optimal conditions: rare earth content, Ce/Y, pH value of the chemical blending and calcination treatment temperature was 3%, $Ce_xY_{(1-x)}$(x=0.9), 7 and 350°C, respectively, was identified as the most active catalyst for the NO decomposition, and the denitration rate could be up to 67.3% under the experimental reaction conditions.

Introduction

Palygorskite, the theoretical structural formula $(Mg, Al, Fe)_5(Si_8O_{20})(OH)_2(OH_2)_4.4H_2O$, is a crystalline hydrated magnesium aluminum silicate with a lath or fibrous morphology. Commonly the claviform particle is a nanoscale fiber with several tens of nanometers in diameter and several hundreds of nanometers in length. The crystal lattice structure of palygorskite exhibits similarities to layered silicates in that the central octahedral sheet is sandwiched in between two tetrahedral silica sheets. But these octahedral sheets are not continuous in the palygorskite. This structural characteristic of the single nanofiber produces certain surface channels and internal tunnels [1]. Due to its unique structure, palygorskite commonly possesses a large specific surface area, considerable porosity, excellent surface activity and thermal stability and is widely used as catalyst or catalyst carriers [2, 3]. CeO_2 and Y_2O_3 have special crystal structure, unique electronic structure and good thermal stability. So both of them received a considerable attention in industrial catalysis as the active components [4,5].

NO is an important air pollutant because of serious harm for human health and ecological environment. Several methods, especially the catalytic removal [6-8], have been developed for NO removal to meet the increasingly stringent regulations on nitrogen oxide emissions. In this study, a series of Ce-Y-palygorskite catalysts for NO decomposition were prepared by chemical blending method. A fixed bed flow reactor was used to optimize the catalytic properties of the catalyst. In addition, we focused on discussing the effect of preparation condition on the catalytic performance.

Experimental

Materials. Palygorskite was purchased from Subei liuhe palygorskite clay Co. LTD (Jiangsu, China). Its chemical composition was SiO_2 (56.1%), Al_2O_3 (13.2%), MgO (8.0 %), CaO (9.8 %), Fe_2O_3 (8.1%), TiO_2 (1.3%), MnO (0.08%), K_2O (0.08%), Na_2O (0.08%). $Ce_2(CO_3)_3$ (content = 99.99%) and Y_2O_3 (content = 99.99%) were from Ganzhou Qiandong Rare Earth Group Co. LTD (Ganzhou, China), NO (content = 0.4%), N_2 (content = 99.99%) and compressed air were from Nanchang grand Gas Co. LTD (Nanchang, China).