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Cu–Mn bimetal catalysts based on SAPO-34 for NO_x removal by NH_3-SCR from diesel engine exhaust

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ABSTRACT

In this study, the microporous SAPO-34 molecular sieve was synthesized by the hydrothermal method with a mixture of three templates including triethylamine, tetraethylammonium hydroxide, and morpholine, which led to unique properties for the support and production cost reduction. Meanwhile, Cu/SAPO-34, Mn/SAPO-34, and Cu-Mn/SAPO-34 were prepared through the ion-exchanged method in aqueous solution. The catalysts were evaluated in the removal of NO_x from diesel exhaust gases under selective catalytic reduction (SCR) process in a fixed bed catalytic reactor. The physicochemical properties of the synthesized catalysts were characterized by several techniques such as X-ray diffraction (XRD), field emission scanning electron microscopy (FE-SEM), energy-dispersive X-ray spectroscopy (EDS), surface area/pore volume measurements, temperature-programmed desorption by ammonia (NH_3-TPD). Electron paramagnetic resonance (EPR) was also used to investigate the fresh and aged catalysts, determine the coordination and valence state of active species. The catalytic performance of the catalysts for the removal of NO_x by NH_3-SCR was investigated by a fixed-bed flow reactor. The original crystal and physical structure of SAPO-34 are maintained in the catalysts, and Cu–Mn/SAPO-34 exhibits high deNOx activity, hydrothermal stability, even in thepresence of water.

Introduction

NO_x is an abbreviated word for various kinds of nitrogen oxides, which primarily relates to nitrogen dioxide (NO_2) and nitrogen monoxide (NO). These gases come from either stationary source such as electric utilities, industrial or mobile sources like automotive diesel engines [1]. NO_x can make some serious impacts on both environment and human health, e.g., acid rain, photochemical smog, global warming, nose and eye irritation, respiratory diseases, etc [2]. Those negative effects have drawn remarkable attention for researchers to figure out a solution to control NO_x concentration, particularly from diesel engines exhaust. Among many NO_x degradation methods, selective catalytic reduction (SCR), which uses ammonia (NH_3) as a reductant, has been widely applied for the removal of NO_x from stationary sources