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Catalytic performance of Ag/Fe_2O_3 for the low temperature oxidation of carbon monoxide

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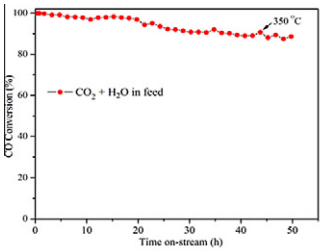
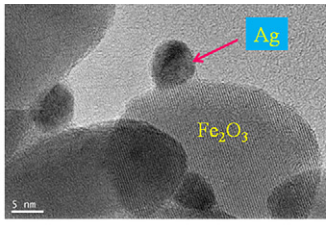
HIGHLIGHTS

- Ag/Fe_2O_3 shows a high activity and stability in low temperature CO oxidation.
- Ag nanoparticles (around 5 nm) are highly dispersed on the surface of Fe_2O_3.
- Supported silver nanoparticles exhibits stable performance in CO oxidation.

GRAPHICAL ABSTRACT



Long-term stability of 15% Ag/Fe_2O_3



Highly dispersed Ag nanoparticles on the surface of Fe_2O_3

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ABSTRACT

In this paper, the effect of impregnated Ag nanoparticles into Fe_2O_3 support in catalytic low temperature CO oxidation was investigated. The nanocatalysts were prepared with a conventional impregnation method. The prepared samples were characterized by X-ray diffraction (XRD), N_2 adsorption/desorption, Temperature programmed reduction (TPR) and Transmission electron microscopy (TEM) techniques. It is clearly observed from the TEM images that the Ag nanoparticles are highly dispersed on the surface of Fe_2O_3 and are mostly around 5 nm in size. The results reveal that the catalytic activities increased significantly by increasing the Ag content, which causes a strong interaction with the Fe_2O_3. The catalytic activity clearly correlates with the Ag–Fe_2O_3 interaction. The experiments showed that the Fe_2O_3 supported silver catalyst has a good reproducibility and is highly stable for CO oxidation for a 50 h period of time even in the presence of high amount of moisture and CO_2 in the feed gas.

1. Introduction

Carbon monoxide is a strongly toxic gas. It directly takes part in the formation of the ground-level ozone and increases the greenhouse effect due to transformation to CO_2 and stabilization of CH_4 in the atmosphere. The presence of carbon monoxide in the atmosphere results from the living process, volcanic activity or bushfires. The condition of the environment and the human health are directly related to the anthropogenic emission. There are numerous and different sources of carbon monoxide formation, e.g. transport, energy production, agriculture, chemical and steel industry. One of the most efficient ways of its removal is catalytic combustion [1]. Catalytic oxidation of carbon monoxide at low temperature remains an intense and important research topic at present [2,3]. CO oxidation is of considerable interest due to its relevance in many industrial applications, such as gas purification in CO_2 lasers, CO sensors, air-purification devices for respiratory protection, and pollution control devices for reducing industrial and environmental emissions [4]. Both platinum group metals and transition metal oxides have been found to catalyze the oxidation

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