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Fire Smoke Removal over Cu-Mn-Ce Oxide Catalyst with CO_2 Sorbent Addition: Co Oxidation and in-situ CO_2 Sorption

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Abstract : In a fire accident, fire smoke often poses a serious threat to human safety especially in the enclosed space such as submarine and space-crafts environment. Efficient removal of the hazardous gas products particularly a large amount of CO and CO_2 gases from these confined space is critical for the security of the staff and necessary for the post-fire environment recovery. In this work, Cu-Mn-Ce composite oxide catalysts coupled with CO_2 sorbents were prepared using wet impregnation method, solid-state impregnation method and wet/solid-state impregnation method. The as-prepared samples were tested dynamically and isothermally for CO oxidation and CO_2 sorption and further characterized by the X-ray diffraction (XRD), nitrogen adsorption and desorption, and field emission scanning electron microscopy (FE-SEM). The results showed that all the samples were able to catalyze CO into CO_2 and capture CO_2 in situ by chemisorption. Among all the samples, the sample synthesized by the wet/solid-state impregnation method showed the highest catalytic activity toward CO oxidation and the fine ability of CO_2 sorption. The sample prepared by the solid-state impregnation method showed the second CO oxidation performance, while the coupled sample using the wet impregnation method exhibited much poor CO oxidation activity. The various CO oxidation and CO_2 sorption properties of the samples might arise from the different dispersed states of the CO_2 sorbent in the CO catalyst, owing to the different preparation methods. XRD results confirmed the high-dispersed sorbent phase in the samples prepared by the wet and solid impregnation method, while that of the sample prepared by wet/solid-state impregnation method showed the larger bulk phase as indicated by the high-intensity diffraction peaks. Nitrogen adsorption and desorption results further revealed that the latter sample had a higher surface area and pore volume, which were beneficial for the CO oxidation over the catalyst. Hence, the Cu-Mn-Ce oxide catalyst coupled with CO_2 sorbent using wet/solid-state impregnation method could be a good choice for fire smoke removal in the enclosed space.

Keywords : CO oxidation, CO_2 sorption, preparation methods, smoke removal
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