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In situ X-ray absorption investigation of the effect of Sm₂O₃ and CeO₂ promoters on the structure of Rh/Al₂O₃ catalysts in methane steam reforming

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The role of Sm₂O₃ and CeO₂ promoters on the structural properties and catalytic behavior of 0.5 wt% Rh/xSm₂O₃-yCeO₂-Al₂O₃ catalysts during methane steam reforming (MSR) was investigated by in situ X-ray absorption spectroscopy and other characterization methods. Catalytic tests were performed at 773 and 1033 K. The combination of XAS measurements with mass spectrometer provided a way to analyze conversion and structure simultaneously. The effect of the addition of Sm₂O₃ and CeO₂ on the catalytic behavior of Rh/Al₂O₃ catalysts was revealed by changes on the structure properties of Rh particles. The high activity observed for the studied Rh catalysts during reaction was mainly attributed to the high dispersion of the active phase. The improvement in the activity and stability of promoted catalysts is due to the greater Rh-support interaction, which inhibited Rh oxidation and the sintering of the Rh particles, thus maintaining the high dispersion during the drastic reaction conditions. The EXAFS experiments clearly illustrate the alteration of the topology and therefore the lack of stability of rhodium particles when supported in unpromoted alumina.

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