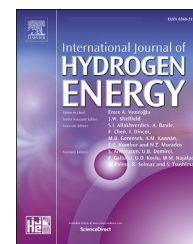


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# Effect of surface properties controlled by Ce addition on CO<sub>2</sub> methanation over Ni/Ce/Al<sub>2</sub>O<sub>3</sub> catalyst

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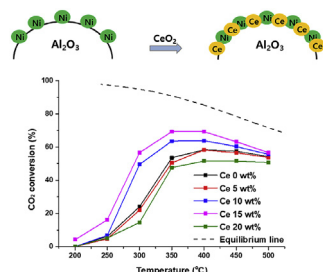
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## HIGHLIGHTS

- Effect of CeO<sub>2</sub> addition to Ni/γ-Al<sub>2</sub>O<sub>3</sub> catalysts on CO<sub>2</sub> methanation is investigated.
- Ni/15Ce/Al<sub>2</sub>O<sub>3</sub> showed good selectivity toward CO<sub>2</sub> methanation at low temperatures.
- Physical properties of the catalyst have little influence on CO<sub>2</sub> methanation.
- Oxidation state and chemical properties significantly affect CO<sub>2</sub> methanation.
- CO<sub>2</sub> methanation efficiency is independent on the amount of Ce<sup>3+</sup>.

## GRAPHICAL ABSTRACT



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## ABSTRACT

Ce-promoted Ni/Al<sub>2</sub>O<sub>3</sub> catalysts with Ce contents of 0, 5, 10, 15, and 20 wt% were investigated for CO<sub>2</sub> methanation. Ni/15Ce/Al<sub>2</sub>O<sub>3</sub> showed good selectivity and catalytic performance in CO<sub>2</sub> methanation and remained stable at 350 °C for 80 h with minor fluctuations. Interactions between Ni and the Ce/Al<sub>2</sub>O<sub>3</sub> support was characterized using X-ray diffraction, temperature-programmed reduction of H<sub>2</sub>, temperature-programmed desorption of CO<sub>2</sub>, X-ray photoelectron spectroscopy, Raman spectroscopy, and thermogravimetric analysis. Addition of Ce did not increase the catalytic surface area, which can significantly enhance the heterogeneous catalytic activity. However, XPS analysis showed that the Ce on the Ni/Al<sub>2</sub>O<sub>3</sub> catalyst changed the surface electron states of Ni, Ce, and O. Additionally,

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