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Low-Temperature CO2 Methanation over Ni/Ce-Sm Oxide Catalysts — •Rachow Fabian, Sichen Liu, Evgenia Charlafti, Raquel Sánchez-Barquilla, and Jan Ingo Flege — Brandenburg University of Technology, Cottbus-Senftenberg, Germany

Nickel catalysts on doped ceria are attractive for CO_2 methanation due to their redox flexibility and potential for improved efficiency and stability. In this work, we investigate Ni supported on mixed Ce–Sm oxides with Ce:Sm ratios of 3:1, 2:1, and 1:1. The catalysts are tested as powders in a fixed-bed flow reactor between 250 and 400°C and benchmarked against a conventional Ni/Al_2O_3 catalyst. Among the compositions, the Ce:Sm ratio of 2:1 shows the highest CO_2 conversion, with a pronounced enhancement in low-temperature activity compared to Ni/Al_2O_3. To relate performance to material properties, we combine X-ray diffraction (XRD), temperature-programmed reactivity (H_2-TPR), Raman spectroscopy, high-resolution transmission electron microscopy (HRTEM/EDX), as well as in-situ X-ray absorption near-edge spectroscopy (XANES) under reaction conditions, elucidating how Sm incorporation and Ce:Sm ratio influence the structural and redox characteristics of the oxide support, oxygen vacancy formation, and Ni dispersion, which together govern catalytic activity and stability. To assess practical applicability and scale-up, the optimized Ni/Ce–Sm (2:1) oxide formulation is deposited on Al_2O_3 spheres and evaluated under conditions representative of packed-bed operation with a limited amount of active material, revealing high conversion and stable, efficient operation in low-temperature CO_2 methanation.

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