CO_2 HYDROGENATION OVER CERIA-BASED TRANSITION METAL NANOCATALYSTS

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ABSTRACT

The hydrogenation of CO_2 to value-added products by means of green H_2 has gained increasing attention for mitigating CO_2 emissions and utilizing the excess power of renewable energy sources. Ceria-based transition metal catalysts have received significant attention due to their intrinsic properties in conjunction with their lower cost as compared to noble metal-based catalysts. In the present work, CO_2 hydrogenation is studied over a series of M/CeO_2-NR catalysts (M/Ce = 0.25 atomic ratio), employing first raw 3d transition metals (Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn) as the active metal phase and rod-shaped ceria as support. The as-prepared materials were thoroughly characterized by various complementary characterization techniques, involving BET, XRD, SEM/EDS, TEM and TPR, in order to gain insight into structure-performance relationships. According to the catalytic results, the CO_2 conversion performance of M/CeO_2-NR catalysts is strongly dependent on the metal entity, following the trend: Ni > Co > Cu > Fe > Zn > Cr ≈ Ti ≈ V ≈ Mn. In particular, Ni/CeO_2-NR exhibits by far the best performance, offering ~90% conversion at 300 ^oC. Moreover, all the M/CeO_2-NR systems, except those of Ni and Co, are mainly selective to CO. Both the CO_2 hydrogenation activity and selectivity can be closely related to the intrinsic features of each metal in relation to its ability to activate CO_2 and dissociate H_2.

KEYWORDS: CO_2 hydrogenation, transition metals, ceria nanorods

Acknowledgements: This research has been co-financed by the European Union NextGenerationEU under the call RESEARCH – CREATE – INNOVATE 16971 Recovery and Resilience Facility (project code: TAEDK-06169).