Bimetallic Fe-Cu catalysts supported on Ceria for CO_2 valorization by reverse water gas shift reaction

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Abstract
The reverse water-gas shift (rWGS) reaction represents a direct route and a promising approach for CO_2 conversion, in order to mitigate CO_2 emissions by producing value-added chemicals using carbon dioxide as a carbon pool. The generated CO, combined with hydrogen, acts as a feedstock to valuable fuels such as methanol and dimethyl ether (DME). The aim of this study is to evaluate the performance of novel bimetallic Fe-Cu catalysts supported on ceria towards rWGS. In fact, despite the long commercial application of WGS, there is a need for novel catalysts characterized by higher intrinsic activity (especially at relatively low temperatures), good thermal stability, and high conversion and selectivity rates.
In this work, bimetallic Fe-Cu catalysts supported on ceria, characterized by a very low active phase content (Fe_2O_3+CuO < 5 wt.%), were prepared, characterized, and tested. Additionally, bare Fe_2O_3/ceria and CuO/ceria and commercial Clariant ShiftMax® 120 HCF catalysts were tested for comparison. Fresh and used samples were characterized by ICP-MS, XRD, N_2 physisorption, SEM-EDS, to relate physico-chemical features and catalytic activity.

The sample with Fe/Cu ≈ 1 and 4 wt.% active phase content showed the best catalytic properties in terms of turnover frequency, no methane formation, stable performance, and conversion rates. Its unique properties were due to both a strong Fe-Cu interaction and a strong metal-support interaction, leading to outstanding redox behavior.