Morphological, Structural, and Chemical Properties of Thermally Stable Ni-Nb2O5 for Catalytic Applications

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Structural stability is a pivotal property required for Nb_2O_5 to be applied as a solid-acid catalyst in heterogeneous catalytic reactions. When combined with Ni, Nb_2O_5 produces cheap and active hydrogenation catalysts. Ni-Nb_2O_5 operates as a bifunctional catalyst and is being widely explored for various catalytic applications without, however, exploring its structural stability and its effects on catalytic activity and durability. Herein, we studied two forms of niobia, one with nonuniform morphology and another comprising a nanorod morphology.

Various selected Ni loadings were dispersed on the two supports via a deposition−precipitation method. Physical and chemical characterization revealed that morphological control in combination with a highly efficient Ni deposition method is key in producing a structurally stable Ni-Nb_2O_5 catalyst. High surface area and porosity as exhibited by the Nb_2O_5 nanorods, in the pseudohexagonal phase, combined with small, well-dispersed Ni particles, provide a structurally stable material up to 500 °C, with high acidity (Lewis and Brønsted acid sites). Moreover, the local and long-range order, characterized in situ (XANES and XRD), determined the temperature limits for the optimization of metallic Ni particles in relation to the Nb_2O_5 structure. *Published in J. Phys. Chem. C (2019), 123, 3130−3143*

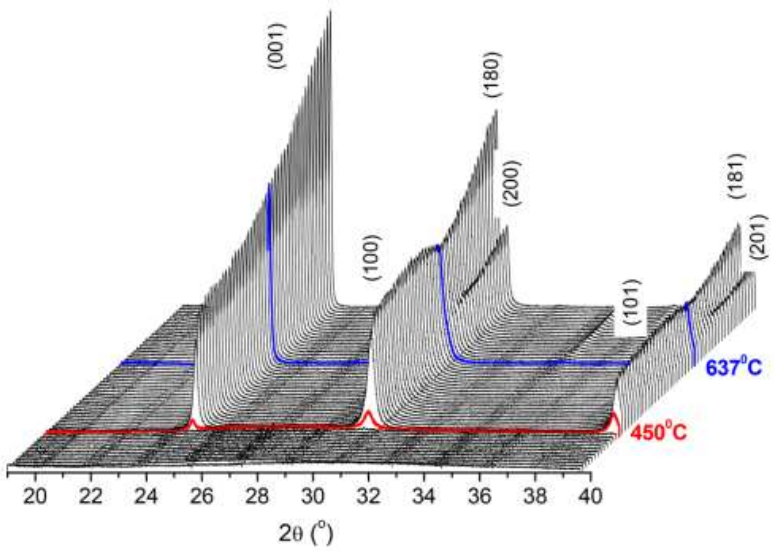

Figure 1. In-situ synchrotron XRD of Nb_2O_5-BH showing the evolution of the diffraction peaks between 2θ =29.5° and 36.9°. Crystallization of the TT-phase (pseudohexagonal) shown in red and the phase transition to the T-phase (orthorhombic) shown in blue. JCPDS 7-61 and JCPDS 30-873.