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Investigation on the Kinetic Mechanism of the Reduction of Fe_2O_3/CoO-Decorated Carbon Xerogel

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Abstract : The reduction of CoO/Fe_2O_3 oxides supported on carbon xerogels was studied to elucidate the effect of nano-size distribution of the catalyst in carbon matrices. Resorcinol formaldehyde xerogels were synthesized, impregnated with iron and cobalt nitrates, and subsequently heated to obtain the oxides. The mechanism of oxide reduction to metal was investigated by in-situ synchrotron X-ray diffraction in dynamic, non-isothermal conditions. Kinetic profiles of the reactions were obtained by plotting the diffraction intensities of selected Bragg peaks vs. temperature. The extracted Temperature-Programmed-Reduction (TPR) diagrams were analyzed by appropriate kinetic models, leading to best results with the Avrami-Erofeev model for all reduction reactions considered. The activation energies for the two-step reduction of iron oxide were 65 and 37 $kJmol^{-1}$, respectively. The average value for the reduction of CoO to Co was found to be around 21 kJ mol^{-1}. Such results may contribute to develop efficient and inexpensive non-noble metal-based catalysts in element form, e.g., Fe, Co, via heterogenization of metal complexes on mesoporous supports.

Keywords : non-isothermal kinetics, carbon aerogel, in-situ synchrotron X-ray diffraction, reduction mechanisms
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