H_2 reduction reaction of Cu_xNi_{1-x}/CeO_2 (x = 0, 0.5, 1) nanoparticles

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Ceria (CeO_2) is an advanced material used for catalytic applications mainly because oxygen vacancies at the surface can be rapidly formed and eliminated which gives to ceria the property of high capacity for oxygen storage [1]. Compared to different supports of metallic nanoparticles, ceria enhances the performance of catalysts in a variety of reactions such as the water gas-shift and the preferential oxidation of CO [1]. The reduction reaction is a key process employed in catalytic applications and it is very important to elucidate the atomic phenomena (core-shell structure formation, changes on the oxidation state, SMSI effect) existing in the nanoparticles in order to project the final desired properties of the catalysts. We have investigated *in situ* and *ex situ* the electronic and structural properties of Cu-Ni nanoparticles supported on CeO_2 and subjected to H_2 reduction. The metallic nanoparticles (~ 5 nm diameter) were synthesized by using the ionic liquid $BMIBF_4$ [2]. Thereafter, the nanoparticles were supported on CeO_2 and heated up to 500 ^oC in a H_2 atmosphere. The system was investigated by means of XPS (X-Ray Photoelectron Spectroscopy) and *in situ* XAS (X-Ray Absorption Spectroscopy) and DXAS (Dispersive XAS) techniques. All XAS measurements were performed in the transmission mode at the Ce L_{III} edge, Ni K edge and Cu K edge. The XPS and DXAS results show that Cu and Ni atoms were initially oxidized. Structural information was obtained by XAS technique and DXAS measurements reveal details about the kinetic of the H_2 reduction as a function of the reduction temperature and time. The reduction of the nanoparticle starts at ~285 ^oC for Cu/CeO_2, ~160 ^oC for Ni/CeO_2, ~190 ^oC (Cu) and ~435 ^oC (Ni) for $Cu_{0.5}Ni_{0.5}/CeO_2$ nanoparticles. After the beginning of the reduction it takes ~10 min for Cu/CeO_2, ~14 min for Ni/CeO_2, ~12 min (Cu) and ~14 min (Ni) for $Cu_{0.5}Ni_{0.5}/CeO_2$ to reduce completely the nanoparticles supported. The atomic arrangement at the surface of the nanoparticles is discussed based on the XPS results.

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