

High Resolution Electron Energy Loss Spectroscopy of CeO₂

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Cerium dioxide (CeO₂, ceria), has attracted much attention in heterogeneous catalysis, which is due to the fact that without major structural transformations, it is possible to simply reduce Ce⁴⁺ ions to Ce³⁺ in a reversible way. According to that process, CeO₂ can serve as an oxygen storage-and-release reservoir, which makes it a perfect supporting material in a variety of oxidation reactions. The mechanism of the selective hydrogenation reaction over CeO₂ has been studied theoretically and investigated experimentally, however further evidence is required. The results of previous IR spectroscopy and NRA studies revealed that on the stoichiometric CeO₂ (111) surface, H species are mostly located on the oxide surface as hydroxyls. In the case of reduced CeO_{2-x} (111) thin films, H species can be found in the bulk volume, as well as the surface. High-resolution electron energy loss spectroscopy (HREELS) is a popular technique, which is mainly used to obtain the vibrational signature of surface and adsorbate species under ultrahigh vacuum conditions. By assigning the vibrational modes, it is possible to confirm previous results on CeO₂ (111). Moreover, we noticed that depending on the reduction state of the film, and dosing parameters, ceria can store large amounts of hydrogen, which stabilizes the structure. By using TPD and DFT methods, we are able to identify hydrogen species. Future experiments will focus on both the morphology of the film and possible reactions using the hydrogen reservoir.

References

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