

MICROXRD AND XPS STUDY OF THE DYNAMIC NATURE OF CERIUM OXIDE NANOPARTICLES – INFLUENCE OF AGING AND CHEMICAL ENVIRONMENT

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EMSL's microXRD capability has been effectively used to understand the fundamental questions related to the dynamic nature of ceria nanoparticles (CNPs). CNPs are a subject of increasing attention in the biomedical field in addition to many traditional applications such as catalysis, sensors, and fuel cells. Most of the applications of CNPs are driven by its oxygen buffering capability, which is guided by the ability of cerium to switch between 3+ and 4+ oxidation states. The thermodynamic stability of oxygen vacancies in the particles below 10 nm makes this switching more efficient. Motivated by this fact, the CNPs have been used to study their biological response (cell longevity, toxicity and related aspects) and the preliminary results have shown excellent radical scavenging ability. It has also been noted that the CNPs can effectively regenerate the active redox state. However, despite a number of investigations on CNPs, the mechanism of oxidation state switching is not clear. MicroXRD and XPS measurements were carried out *in situ* on the CNPs, and the influence of H₂O₂ has been analyzed. Our data indicates that an intermediate phase nucleates immediately after the addition of H₂O₂ to the CNPs. Further analysis with Raman spectroscopy has been used to confirm that the intermediate phase is a cerium oxy peroxide complex. It is believed that the, formation of the oxy peroxide phase drives the oxidation state switching in nanoceria. In addition to the results from this study, and their implications to bio-medical applications, plans for future capability development for the microdiffraction instrument at EMSL will also be outlined.