Title: Study of cerium oxide thin films for biosensing applications

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Abstract:

The presented scientific work was conducted in two main directions. The first one is an investigation of the simple biomolecules (glycine and sarcosine) bonding to cerium oxide model films by surface science techniques: photoelectron and near-edge X-ray absorption spectroscopies. Adsorption chemistry and thermal stability of the molecules on the oxides were studied in relation to the oxidation state of ceria cations, film morphology, and molecular deposition method. The oxygen vacancies in the oxide were shown to affect the adsorption geometry of glycine and stimulate molecular decomposition. The polycrystalline oxide morphology provided stabilizing effect on the glycine adlayer. Sarcosine deposited in vacuum formed densely packed adlayer with the molecules directed outwards. Interestingly, the results revealed that molecular film deposited from the aqueous solution, in contrast to deposition in vacuum, induces continuous reduction of the cerium oxide during thermal annealing. The second part is a study of polycrystalline cerium oxide thin films as an electrode for electrochemical and electrochemiluminescent detection of hydrogen peroxide and sarcosine, respectively. We confirmed the enzymatic properties of the cerium oxide in electrochemical oxidation of hydrogen peroxide. For sarcosine detection, the polycrystalline CeO_2 film was demonstrated to be an efficient cathode material for the model electroluminescent sensing systems.

Keywords:

Cerium oxide, biosensor, hydrogen peroxide, amino acid, photoelectron spectroscopy.