

Nanocomposites and nanomaterials

Catalase mimetic activity of carbon supported nanoceria

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Nanoceria is highly catalytic material that can mimic the properties of natural enzymes [1]. The purpose of this work is to study catalase mimetic activity of nanoceria supported on different carbon materials.

Multi-walled carbon nanotubes (Nanothinx S.A.), activated carbon (KAU, from apricot stones) and graphite Micro 850 (Asbury Graphite Mills, Inc., USA) were used to produce nanocomposites with different nanoceria content by the reaction of cerium nitrate deposition in the presence of carbon materials: $4\text{Ce}(\text{NO}_3)_3 + 12\text{NaOH} + \text{O}_2 = 4\text{CeO}_2 + 12\text{NaNO}_3 + 6\text{H}_2\text{O}$.

The morphology of the nanomaterials was studied by transmission (TEM, Hitachi H 800 instrument) and scanning electron microscopy (SEM, MIRA3 LMU, TESCAN instrument with a resolution of 1 nm). The content of cerium oxide in nanomaterials was determined by atomic emission spectrometry (ICPE9000 device, Shimadzu). Optical properties of nanomaterials in the UV, visible and near-IR were recorded on an UV-VIS-NIR-spectrometer UV-3600, Shimadzu in diffuse reflection mode in the 220–2600 nm diapason with the uncertainty of ± 0.25 nm.

Catalase mimetic activity of nanocomposites, pristine carbon materials and nanoceria was studied in the reaction of H_2O_2 decomposition at room temperature and pH from 8 to 11. To obtain the kinetics data, the volume of released oxygen was measured. The enzyme mimetic activity of the materials was evaluated using the Michaelis constant (K_M , M) that was calculated from Lineweaver – Burke plot.

The results show that there is an extremal correlation between enzyme mimetic activity and pH of the environment for nanoceria and nanocomposites with the pH-optimum at 8.5 – 9.5. It was also found that all nanocomposites have higher catalytic activity than pristine nanoceria, which makes them promising materials for peroxide substances decomposition.

1. *Wei H., Wang E.* Nanomaterials with enzyme-like characteristics (nanozymes): next-generation artificial enzymes // *Chem. Soc. Rev.*-2013.-**42**.-P. 6060-6093.