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Nano 2020: Composites of Cerium Oxide Nanoparticles and Carbon Compounds for Detection of Hydroxyl Free Radicals - Dong-Shik Kim - University of Toledo

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Reactive oxygen species (ROS) are well known for their extreme reactivity. Due to their significant impact on industries, environment, and human health, ROS have been extensively studied in chemical, biological, environmental, and medical research fields. Hydroxyl radical reacts with functional groups in the polymer electrolyte membrane (PEM) used in fuel cells, and causes damages that lead to fuel cell failure. In medical and clinical fields, ROS are closely related to diseases such as Alzheimer's, Parkinson's and multiple sclerosis, and detection of abnormal levels of free radicals at an early stage of disease is important for prevention and treatment of the diseases. Currently available methods for detecting the type and concentration of free radicals use either radical trapping or fingerprinting methods that require high costs of equipment and operation, and produce inaccurate and inconsistent results.

We synthesized a nanocomposite consists of cerium nanoparticles (CeNPs) and carbon compound deposited on a glassy carbon electrode. The CeNP nanocomposite sensor successfully detected hydroxyl free radicals at as low as 0.006 mM using cyclic voltammetry (CV). The size of CeNP and its loading ratio are found to significantly affect the sensitivity of the sensor. The average particle sizes, 8-16 nm with the loading ratios of 10-75, and 90 wt% were tested for their sensitivity with hydroxyl radicals. The composite with 8 nm CeNPs with 50 wt% loading showed the largest current response with hydroxyl radicals. The load ratio was observed to affect the ratio of Ce3+/Ce4+ that determines the sensitivity of the sensor.

Introduction

TPP-connected ceria (CeO2) NPs go about as fiery ROS scroungers in mitochondria by progressing somewhere in the range of Ce3+ and Ce4+ oxidation states and at last lessen cell passing in 5XFAD AD model mice. These NPs hinder receptive gliosis and mitochondrial brokenness in mice. These NPs introduced stable hydrodynamic distance across and colloidal security when hatched with phosphate-cradled saline (PBS) and Dulbeccos changed Eagle's Medium (DMEM) and 10% fetal ox-like serum (FBS).

In another examination, Ce3+ and Ce4+ progress property has been utilized to treat mitochondrial splitting. Consequently, nanoceria were utilized which were profoundly limited in mitochondrial external film and contradicted Aβ and peroxynitrite induced mitochondrial parting. Peroxynitrite for the most part assumes a fundamental job in Aβ total and neurofibrillary tangle (NFT) development. This impact of mitochondrial parting and cell passing has been provoked through actuation of dynamin-related-protein1 (DRP1), a monstrous GTPase that encourages mitochondrial splitting by heretofore unidentified atomic instruments. By the by, DRP1 serine 616 phosphorylation assumes a potential job. Cerium oxide NPs effectively kills superoxide anions, hydrogen peroxide, and peroxynitrite. They additionally strongly repress ROS and receptive nitrogen species (RNS).

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