IRON OXIDE-CHROMATE CORE-SHELL NANOSTRUCTURE FOR THE ELECTROCHEMICAL BIOSENSING OF POLYAMINES IN LIVER CANCER TISSUES

MAGRO Massimiliano, BONAIUTO Emanuela, BARATELLA Davide, JAKUBEC Petr, SCONCERLE Elisabetta, TERZO Milo, MIOTTO Giovanni, MACONE Alberto, AGOSTINELLI Enzo, FASOLATO Silvano, TUCEK Jiří, ZBORIL Radek, VIANELLO Fabio

University of Padua, Padua, Italy, EU

Palacky University of Olomouc, Regional Centre of Advanced Technologies and Materials, Olomouc, Czech Republic, EU

Abstract

A novel core-shell hybrid nanomaterial based on surface active maghemite nanoparticles (SAMNs) and chromate Cr2O72- was developed. The SAMN@Cr2O7 complex was characterized by in field (5 T) Mössbauer spectroscopy at 5 K, which showed the appearance of Fe(II) atoms at the interface between nanoparticles and chromium. Moreover, high-angle annular dark-field imaging (HAADF) and electron energy loss spectroscopy (EELS) for elemental mapping in a scanning transmission electron microscope (STEM) in parallel with energy-dispersive X-ray spectroscopy analysis, mapped chromium distribution on SAMN surface mirroring iron(III) binding sites distribution. Furthermore, electrochemical techniques showed lower charge transfer resistances, higher capacitive current, better electrochemical performances, as well as more reversible electrochemical behavior with respect to bare SAMNs. Chromium shell improved electrocatalytic properties of SAMNs toward hydrogen peroxide electroreduction. Furthermore, an enzyme, namely, bovine serum amino oxidase (BSAO), was immobilized on the surface of SAMN@Cr2O7, leading to an biologically active bio-nano-conjugate for polyamine oxidation (SAMN@Cr2O7-BSAO), which was exploited for the development of a new reagentless electrochemical biosensor for polyamine detection. The system successfully distinguished tumor tissues from healthy liver by polyamine content in human liver extracts from biopsies.

Keywords: Maghemite, hybrid nanomaterial, chromium, bovine serum amine oxidase, polyamine biosensor, hepatocellular carcinoma

Author did not supply full text of the paper.