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Electrochemical and biomagnetic catechol sensor based on polyaniline-iron oxide magnetic nanohybrid

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Polyaniline–iron oxide magnetic nanohybrid was synthesized and characterized with spectroscopic, microstructural and electrochemical techniques. The smart integration of Fe_3O_4 nanoparticles with polyaniline (PANI) yielded a mesoporous nanohybrid (Fe_3O_4@PANI) with high surface area (94 m^2/g) with average pore width of 12.8 nm. Transmission electron microscopy (TEM) revealed granular Fe_3O_4@PANI nanohybrid containing several monodispersed Fe_3O_4 nanoparticles interlaced within the PANI matrix. K-edges of C, N and O of PANI and Fe L2 and L3 edges of Fe3O4 were identified by electron energy loss spectroscopy (EELS). Cyclic voltammetry indicated that catechol is quasi-reversibly oxidized to o-quinone and reduced at the Fe_3O_4@PANI modified electrodes. The amperometric current response towards catechol was observed with sensitivity and detection limit of 312 μA/μL and 0.2 nM, respectively. Electrochemical impedance spectroscopy (EIS) indicated that catechol tends to adsorb faster on the modified electrodes giving rise to increased solution resistance (R_s). Photoluminescence spectra showed ligand-to-metal charge transfer (LMCT) between pπ orbitals of phenolate cathecolate oxygen and dσ* metal orbital of Fe_3O_4@PANI composite. Potential dependent spectroelectrochemical response of Fe_3O_4@PANI towards catechol was studied using UV/Vis/NIR spectroscopy. AC susceptibility measurements support the binding activity of biomagnetic particles with catechol through Brownian relaxation. The peak frequency of the AC susceptibility is inversely proportional to the particle volume, and can be used to monitor the change in the particle volume upon binding of catechol to Fe_3O_4@PANI. The use of Brownian relaxation time in frequency domain provides a platform for developing a biomagnetic sensor.

Biography

Sudeshna Chandra has completed her Ph.D. at the age of 28 years from University of Roorkee and was a Humboldt Fellow at Technische Universität Chemnitz, Germany. Currently, she is a woman scientist in Department of Metallurgical Engineering and Materials Science, Indian Institute of Technology Bombay, India. She has published more than 40 papers in reputed journals and has attended many national and international conferences.

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