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Functional Alkoxysilane Mediated Controlled Synthesis of Prussian blue nanoparticles, Enabling Silica Alginate Bead Development; Nanomaterial for Selective Electrochemical Sensing

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Abstract

We report herein the controlled synthetic strategy for Prussian blue nanoparticles (PBNPs) formation justifying the role of functional alkoxysilanes, [2-(3,4-Epoxycyclohexyl)ethyl]trimethoxysilane (EETMSi) in the presence of tetrahydrofuran hydroperoxide (THF-HPO) with following major findings: (i) significant change in nanogeometry from 40 to 8 nm by addition of EETMSi and (ii) allowed fabrication of PBNPs encapsulated silica-alginate beads. As made nanoparticles were characterized by UV-Vis spectroscopy, TEM, FT-IR, and SEM. Size dependent electrochemical behavior of three different PBNPs i.e. PBNPs-1 (26 nm), PBNPs-2 (17 nm) and PBNPs-3 (8 nm) was recorded based on cyclic voltammetry. Apart from unprecedented size-dependent properties, as made PBNPs-3 display excellent peroxidase mimetic activity with Km value to the order of ~0.9 mM. In addition, EETMSi also allows to cast Prussian blue film and simultaneously enable the formation of silica-alginate beads with controlled pores size perfectly suitable for encapsulating these nanoparticles which allocate selective electrochemical oxidation of Pyrogallol (Py) at 0.3 V vs. Ag/AgCl.

Keywords: PBNPs, H_2O_2, EETMSi, Electrocatalytic activity, silica alginate-bead, Py, o-dianisidine dye.