Experimental and Theoretical Studies of Cholesterol Nanobiosensors

Martins, M.; Fernandes, E.G.R.; França, É.J.; Soares, D.A.W.; de Queiroz, A.A.A.
UNIFEI

Recently our laboratory have been interested in the development of nanostructured enzyme sensors with high performance because of their usefulness in diagnostic analysis of cholesterol. It is well known that elevated serum cholesterol is supposed to be a risk factor in the development of arteriosclerosis and myocardial infarction. We have studied the design of cholesterol biosensors based on poly(vinyl alcohol) (PVA) and copper phthalocyanine (CuPhc), that provide the electron transport between the conductive electrode support and the enzymes incorporated into the polymeric film. We report the utilization of a novel nanoscaled CuPhc-cholesterol oxidase to create a highly responsive cholesterol biosensor. CuPhc nanoparticles embedded in poly(vinyl alcohol) (PVA) are obtained by the method of complexation-mediated solubilization, where CuPhc is dissolved in high concentration in the aprotic organic solvent containing Lewis acid for the formation of electron donor-acceptor complexes. The synthesized CuPhc nanoparticles are characterized by means of UV/VIS absorption and FTIR spectroscopy. The results show that the CuPhc nanoparticles are spherical with a size of 25–50 nm. The blue-shifted absorption for CuPhc nanoparticles are observed. The conductivity of the CuPhc nanoparticles in a single layered photoreceptor is investigated as well. Under optimal conditions, the biosensor shows a linear response to cholesterol in the range of 0.1 mM to 2.6 mM, with a fast response (10 s) and high sensitivity (23.67 nA.cm-2.mM-1). Semiempirical calculations using PM3-d have been performed on the CuPhc/PVA CT complex. The geometry parameters, Mulliken effective atomic charges, heats of formation, ionization potential, HOMO-LUMO energy differences, and dipole moments are also reported and compared with the infrared (FTIR) spectra and conductivity experimental results.

Palavras-Chave:

Biosensor, poly(vinyl alcohol), copper phthalocyanine, cholesterol oxidase