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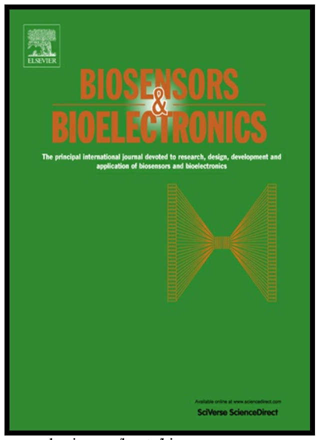

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A highly sensitive and selective sensor based on a graphene-coated carbon paste electrode modified with a computationally designed boron-embedded duplex molecularly imprinted hybrid membrane for the sensing of lamotrigine

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Abstract

An innovative electrochemical sensor, based on a carbon paste electrode (CPE) modified with graphene (GR) and a boron-embedded duplex molecularly imprinted hybrid membrane (B-DMIHM), was fabricated for the highly sensitive and selective determination of lamotrigine (LMT). Density functional theory (DFT) was employed to study the interactions between the template and monomers to screen appropriate functional monomers for rational design of the B-DMIHM. The distinct synergic effect of GR and B-DMIHM was evidenced by the positive shift of the reduction peak potential of LMT at B-DMIHM/GR modified CPE (B-DMIHM/GR/CPE) by about 300mV, and the 13-fold amplification of the peak current, compared to a bare carbon paste electrode (CPE). The electrochemical reduction mechanism of lamotrigine was investigated by different voltammetric techniques. It was illustrated that square wave voltammetry (SWV) was more sensitive than different pulse voltammetry (DPV) for the quantitative analysis of LMT. Thereafter, a highly sensitive electroanalytical method for LMT was established by SWV at B-DMIHM/GR/CPE with a good linear relationship from 5.0×10^{-8} to 5.0×10^{-5} and 5.0×10^{-5} to 3.0×10^{-4} mol L^{-1} with a lower detection limit (1.52×10^{-9} mol L^{-1}) based on the lower linear range(S/N=3). The practical application of the sensor was demonstrated by determining the concentration of LMT in pharmaceutical and biological samples with good precision (RSD 1.04 to 4.41%) and acceptable recoveries (92.40 to 107.0%).

Keywords: Lamotrigine; computational design; duplex molecularly imprinted hybrid membrane; electrochemical sensor.