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Characterization of Caffeine-Imprinted Polypyrrole by a Quartz Crystal Microbalance and Electrochemical Impedance Spectroscopy

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Abstract

The synthesis and some properties of polypyrrole layer molecularly-imprinted by caffeine (MIP-Ppy), which was formed on gold covered quartz crystal, were evaluated by quartz crystal microbalance (QCM). Electrochemical polymerization was applied for the formation of this MIP-Ppy. In the study unique home-made flow-through QCM cell was used for the formation of MIP-Ppy and QCM measurements. The main advantages of the applied flow-through cell design were (i) reduced volume of the cell and (ii) the possibility to perform continuous association/dissociation processes. The performed QCM measurement data proved that the QCM sensor modified with MIP-Ppy is more sensitive to caffeine than to the theophylline. Evaluation of association/dissociation kinetics between caffeine imprinted MIP-Ppy and both xanthine derivatives (caffeine and theophylline) and some parameters of thermodynamics calculated for this interaction demonstrated significant differences, which showed that the MIP-Ppy tends to interact with caffeine more strongly than with theophylline. Electrochemical impedance spectroscopy was applied for the evaluation of MIP-Ppy degradation.

Key words: quartz crystal microbalance (QCM), polypyrrole (Ppy), molecularly-imprinted polypyrrole (MIP-Ppy), caffeine, theophylline.

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