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Analysis of using various modifications of zeolites in electrochemical biosensors

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Zeolites are micro- and nanoparticles, the structure of which is based on crystalline lattice of atoms of silicon, aluminum and oxygen. The negative charge of crystal is neutralized by the cations located inside the pores. Usually in unmodified zeolites these cations are one- or two-valent ions of metals (e.g., sodium), which can be replaced with ammonium ions by ion exchange, and after calcination – with hydrogen ions. Zeolite crystals contain highly ordered structure with a complex pores and channels system. Thus, zeolites have a large surface area of the crystal, which can adsorb different substances. For this reason, zeolites are widely used in various fields as adsorbents (Mintova, Gilson, & Valtchev, 2013). Other important properties of zeolites are low cost and relative ease of their synthesis or production from natural materials, the opportunity to acquire a variety of chemical modifications of the particles to obtain zeolites with the required properties (Rangnekar, Mittal, Elyassi, Caro, & Tsapatsis, 2015).

In this paper, the using of different types of zeolites in the development of a variety of enzyme biosensors based on several types of electrochemical transducers is described along with the analysis of the feasibility. An impact of the type of zeolite, its hydrophobicity (Si/Al ratio) and crystals calcination on the analytical characteristics of biosensors was investigated. The effect of ions replacement in the crystal lattice on the enzyme activity after immobilization was studied. The functioning of biosensors based on coimmobilisation of enzymes with zeolites was investigated depending on the type of transducer (amperometric, conductometric or potentiometric).

Successful biosensor analysis of the concentration of specific substances in real biological samples obviously proves the biosensors working capacity and prospects of using zeolites.