Biocatalytic application of urease immobilized on magnetic nanoparticles with functional polysiloxane layers

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Urea identification is important in biomedical and clinical analysis. Concentration of urea biomolecules in blood provides information about kidneys misfunction. Urea analysis is also of considerable interest for agro and food chemistry, ecological monitoring of environmental pollution caused by heavy metals. Urease, an enzyme that catalyzes the hydrolysis of urea, is often present in a range of biological systems and can be used to analyze the described systems. Thus, current research focuses on urease immobilization on the surface of nanosized magnetite functionalized with alkoxysilanes, determination of the possibility of using such specimens in urea hydrolysis, and analysis of the effect of heavy metals on urease activity in such process.

Magnetite was synthesized by chemical coprecipitation of iron (II) and iron (III) chlorides in the ammonia environment. Then it was functionalized with polysiloxane layers containing amine and thiol groups. Urease immobilization was performed by adsorption or covalent methods. The obtained urease specimens were used in the hydrolysis of pathological concentrations of urea in saline. There was also analyzed the effect of heavy metals (for example, Hg^{2+} and Cu^{2+} ions) on residual activity of urease. Some results are presented in Fig. 1.

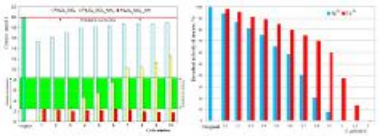

Fig. 1. Biocatalytic application of urease specimens in urea hydrolysis and the effect of heavy metals on the activity of urease.

According to Fig. 1a, the best results were shown by urease specimen immobilized on magnetite with mercapto groups in the surface layer. Such specimen reduces the concentration of urea to normal preparation in all 10 probes. Meanwhile, magnetite containing only polysiloxane layer does not show such properties. Fig. 1b depicts the impact of metal concentration in the solution on the enzyme activity. However, this effect is somewhat different for different metals, thus it can be said that the influence is specific.

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