MAGNETIC STUDIES OF FERROFLUID MODIFIED FODDER YEAST CELLS

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Magnetically modified biocompatible materials, containing magnetic nanoparticles as labels, have attracted much attention because of their great potential as magnetic affinity adsorbents for various biologically active compounds. They have been successfully applied for the magnetic separation of various proteins (enzymes, antibodies, antigens, receptors), nucleic acids (DNA, RNA, oligonucleotides), drugs and xenobiotics (carcinogens, water-soluble dyes, heavy metal ions, radionuclides) [1, 2].

There are many adsorbents available, but the main attention is focused on cheap and easy to get materials. Among them, living or dead microorganisms (yeast, bacteria, fungi, algae) are intensively studied [3].

Various strains of yeast are among the microorganisms, which can be used to removal and degradation of dyes [4]. In addition, the yeast cells efficiently interact with magnetic nanoparticles stabilized as low-pH ionic magnetic fluid, leading to the formation of magnetically labeled cells, which could be easily separated from the system using an appropriate magnetic separator [5].

This work reports on a new magnetic adsorbent – ferrofluid-modified fodder yeast (*Kluyveromyces fragilis*) cells – containing maghemite nanoparticles as magnetic labels. The prepared material was tested as a possible adsorbent for binding of different substances. It efficiently adsorbed selected water-soluble organic dyes, namely, crystal violet, amido black 10 B, congo red, Saturn blue LBRR 200, acridine orange, Bismarck brown Y and safranin O [6].

Analysis of TEM micrographs showed the presence of both isolated magnetic nanoparticles and their aggregates on the cell surface. The maghemite nanoparticles were roughly spherical in shape and externally attached to the *Kluyveromyces fragilis* cells walls; no particles were found inside the cells.

A possibility of using the magnetically modified fodder yeast cells as the magnetic adsorbent in the magnetic separation procedures was tested by means of magnetization and ESR measurements. The prepared material displayed a superparamagnetic behavior at room temperature, with a transition to a blocked state at T_B = 180 K for the applied magnetic field H = 50 Oe.

The room temperature ESR spectrum showed a well-defined single broad signal with the peak-to-peak line width ΔH_{pp} = 898 Oe and an effective g value of about 2.07. The line width of this signal considerably exceeded the magnetocrystalline-anisotropy-determined minimum value, ΔH_{pp} = 400 Oe, for non-interacting single domain maghemite particles. It suggested the existence of non-negligible dipole-dipole interactions between nanoparticles. Upon decreasing the temperature this signal shifted to lower fields and gradually broadened, following closely the predictions for the ESR of superparamagnetic nanoparticles systems.

Ferrofluid-modified fodder yeast cells can thus be a promising magnetic affinity adsorbent which may be used to the removal of dyes by means of magnetic separation techniques.

References:

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Figures:

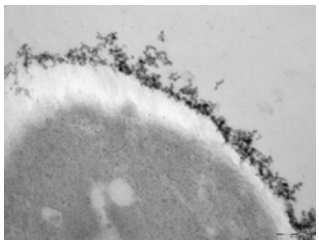

Fig.1. TEM picture of the ferrofluid-modified cell.

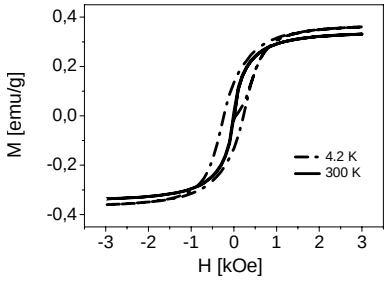

Fig.2. Field dependent hysteresis loops.

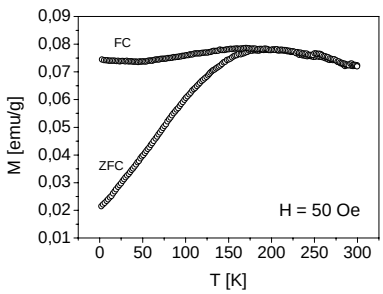

Fig.3. Temperature dependencies of magnetization.

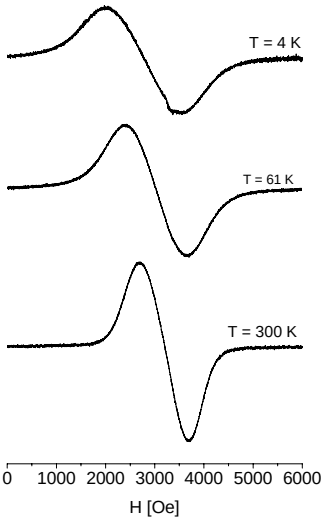

Fig.4. Exemplary ESR spectra.