Perspectives of Sol-Gel Silica Particles Loaded with Cu, Eu for Biomedical Applications

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ABSTRACT

Sol-gel technique has got a huge potential for material production within the research communities worldwide. Obtained via one-step sol-gel synthesis functionalized polysiloxanes are hybrid polymer materials with different functional groups, possessing such characteristics as resistance to highly acidic environments, biocompatibility, lack of swelling in organic solvents, etc. Fabrication of silica particles with different chemical structures and various mechanisms of action is widely used in bionanotechnology. One of the most important requirements of the successful application of such materials is the high content of the available hydrolytically stable functional groups to form the complexes with metal ions which can add antibacterial or biomarker activities. Recently, the task of preparing eco-friendly materials usable for multiple purposes has become of increasing concern [1]. Functionalized amino-silica particles (especially with bifunctional surface layers) are widely used as adsorbents for heavy metal ions. We designed the adsorbents combining on the surface hydrophilic (-NH_2, -OH) and hydrophobic (phenyl, ethyl) groups, basic (amino) and acidic (silanol) groups, complex-forming (amino) and ion-exchange (silanol) groups for solving a complex of water treatment problems, including the removal of Cu(II) and Eu(III) ions (Fig. 1a).

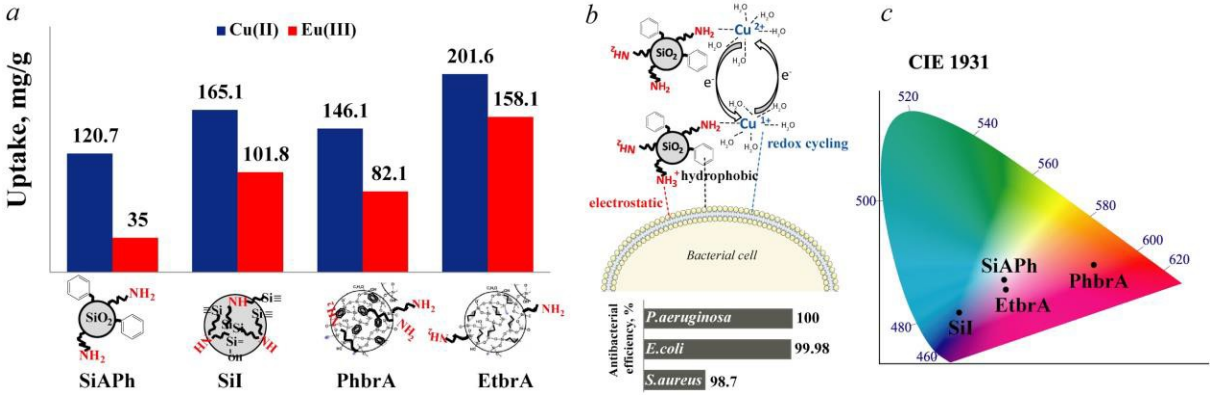

Fig.1. Sorption capacities of aminosilica particles to Cu(II) and Eu(III) ions (a); types of interactions on bacterial cells' surface (b); chromaticity diagram obtained from the luminescence spectra (c)

Water suspension (1%) of Cu(II) loaded SiO_2/-$(CH_2)_3NH_2$/-C_6H_5 particles showed complete growth inhibition (in 120 min) of the bacterial cultures such as *P. aeruginosa, E.coli,* and *S.aureus* on the solid medium due to multiple and nonspecific interactions between the particle surfaces and the surface layers of bacteria, revealing the perspectives of such materials as antimicrobial agents [2] (Fig.1b). Meanwhile, Eu(III) loaded samples, especially with bridges within silica networks, exhibited different light emission (Fig.1c) and this feature can be used for some specific applications, e.g. bioimaging [3].

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References

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