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Article

Synthesis and Antibacterial Activity of (AgCl, Ag)NPs/Diatomite Hybrid Composite

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Abstract. In the present research, hybrid (AgCl, Ag)NPs/diatomite composites were synthesized by direct impregnation with aqueous silver nitrate solutions. The silver chloride nanoparticles (AgCl-NPs) were formed as an effect of the exchange reaction when silver interacted with the diatomite mineral impurity halite. Nanoparticles of metallic silver (AgNPs) were created by the reduction of silver ions under the influence of hydrogen peroxide. The content of silver chloride nanoparticles in the (AgCl, Ag)NPs/diatomite composite was limited by the content of the halite in the used diatomite. Samples of natural diatomite and synthesized (AgCl, Ag)NPs/diatomite composites were examined by using scanning electron microscopy, transmission electron microscopy, X-ray powder diffraction, infrared spectroscopy and thermogravimetric analysis. Moreover, the antibacterial potential of synthesized composites was also studied using the MIC (minimal inhibitory concentration) method against the most common drug-resistant microorganisms in the medical field: Gram-positive *Staphylococcus aureus* and Gram-negative *Klebsiella pneumoniae*. The obtained hybrid (AgCl, AgNPs)/diatomite composites were shown to have antimicrobial potential. However, widespread use requires further study by using various microorganisms and additional cytotoxic studies on eukaryotic systems, e.g., cell lines and animal models.

Keywords: diatomite; silver nanoparticles; (AgCl, Ag)NPs/diatomite composite; antibacterial activity

1. Introduction

Recently, many natural mineral matrices have been actively used as support substrates for metal nanoparticles, e.g., silver nanoparticles, in the production of nanocomposites with specific chemical-biological properties [1]. The interest in mineral matrices appears from the fact that in the case of the conventional synthesis of metal nanoparticles in the form of colloidal solutions, problems such as instability of nanoparticles and their subsequent agglomeration are revealed [2–4]. Furthermore, natural minerals as carriers of metal nanoparticles are nontoxic and environmentally friendly.

The necessary conditions for the synthesis of silver nanoparticle composites based on mineral substrates such as quartz [5–8], talc [9], diatomite [2,10,11], kaolinite [12], montmorillonite [13–16], zeolite [17–19] and mesoporous silica [20,21] have been established. The formation of silver nanoparticles on the surface of mineral substrates can be obtained by ion exchange in silver nitrate solution and further reduction by different methods, such as thermal treatment [16], UV-irradiation,