Fabrication of silver nanoparticles doped in the zeolite framework and antibacterial activity.

Abstract

Using the chemical reduction method, silver nanoparticles (Ag NPs) were effectively synthesized into the zeolite framework in the absence of any heat treatment. Zeolite, silver nitrate, and sodium borohydride were used as an inorganic solid support, a silver precursor, and a chemical reduction agent, respectively. Silver ions were introduced into the porous zeolite lattice by an ion-exchange path. After the reduction process, Ag NPs formed in the zeolite framework, with a mean diameter of about 2.12-3.11 nm. The most favorable experimental condition for the synthesis of Ag/zeolite nanocomposites (NCs) is described in terms of the initial concentration of AgNO(3). The Ag/zeolite NCs were characterized by ultraviolet-visible spectroscopy, powder X-ray diffraction, transmission electron microscopy, scanning electron microscopy, energy dispersive X-ray fluorescence, and Fourier transform infrared. The results show that Ag NPs form a spherical shape with uniform homogeneity in the particle size. The antibacterial activity of Ag NPs in zeolites was investigated against Gram-negative bacteria (ie, Escherichia coli and Shigella dysentriae) and Gram-positive bacteria (ie, Staphylococcus aureus and methicillin-resistant Staphylococcus aureus) by disk diffusion method using Mueller-Hinton agar at different sizes of Ag NPs. All of the synthesized Ag/zeolite NCs were found to have antibacterial activity. These results show that Ag NPs in the zeolite framework can be useful in different biological research and biomedical applications.

Keyword: Silver nanoparticles; Zeolite; Antibacterial activity; Transmission electron microscopy.