Synthesis and antimicrobial study of silver-kaolinite nanocomposites

B. Cabal[1], M. Miranda[2], R. Torrecillas[2], F. Malpartida[3], J.S. Moya[1]
[1]Instituto de Ciencia de Materiales de Madrid (ICMM-CSIC), 28049, Cantoblanco, Madrid, Spain
[2]Centro de Investigación en Nanomateriales y Nanotecnología (CINN), Consejo Superior de Investigaciones Científicas (CSIC) – Universidad de Oviedo (UO) – Principado de Asturias, Parque Tecnológico de Asturias, 33428, Llanera, Spain
[3]Centro Nacional de Biotecnología (CNB-CSIC), 28049, Cantoblanco, Madrid, Spain
bcabal@icmm.csic.es

Microorganism produce a wide range of diseases and they are responsible of contamination of drinking water and the decay of fruits and vegetables [1, 2]. Pathogenic microorganisms with resistance to various antimicrobial agents have risen over the last several years, resulting in increase in morbidity and mortality and overall treatment cost. In this regard, inorganic bactericides have attracted special interest due to their chemical stability, long life and heat resistance [3, 4]. Silver, known as a desinfectant for many years, has a broad spectrum of antibacterial activity. Silver nanoparticles show efficient antimicrobial properties compared to other silver salts due to their extremely large surface area and low solubility, which provides better contact with micro-organisms. Silver nanoparticles in most studies are suggested to be non-toxic in low concentrations, but in high concentration could have toxic effects.

In the present work, a nanocomposite of kaolinite with a low content (1 wt% Ag) of silver nanoparticles is presented. Two different methods were followed to deposited Ag nanoparticles in a controlled way on the kaolinite surface. In the first procedure, the precursor is reduced thermally, while in the second there is a chemical reduction employing in this case sodium borohydride as a reductor agent. In both cases, the first step is the preparation of a kaolin dispersion (9 wt% of solids loading) in the best possible conditions in terms of stability and homogeneity. A dispersant is used (Dolapix CE-64) to improve the suspension stability. All the steps in both procedures to add the silver were carried out in a dark room to avoid the spontaneous reduction of silver cations due to the presence of light. The samples were characterized by TEM, SEM and UV-Visible spectroscopy. Figure 1 and Figure 2 show some TEM images for the samples thermally and chemically reduced. In both cases, in the samples obtained by both reduction procedures, the silver nanoparticles appear perfectly isolated and attached onto the surface of the kaolin particles. The kaolin matrix acts an effective scaffold where the nanoparticles are dispersed, avoiding their agglomeration.

Dehydroxylation of kaolinite it was also studied. The effect of the thermal treatment of kaolinite before and after the incorporation of Ag nanoparticles was evaluated.

The antimicrobial benefits of the composite were evaluated as antibacterial against Gram-negative and Gram positive bacteria, and the antifungal activity against yeast. Escherichia coli JM 110, Micrococcus luteus and Issatchenkia orientalis were selected as models of the Gram-negative bacteria, Gram-positive bacteria and yeast, respectively.

References:

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[3] Trapalis, C.C., Kokkoris, M., Perdikakis, G., Kordas, G., Journal of Sol-Gel Science and Technology, **26** (2003), 1213-1218
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Figures:

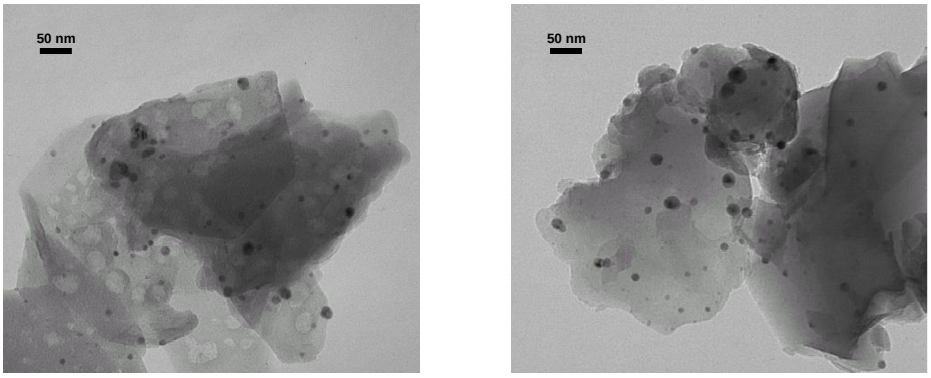

Figure 1. TEM micrographs of the sample thermally reduced

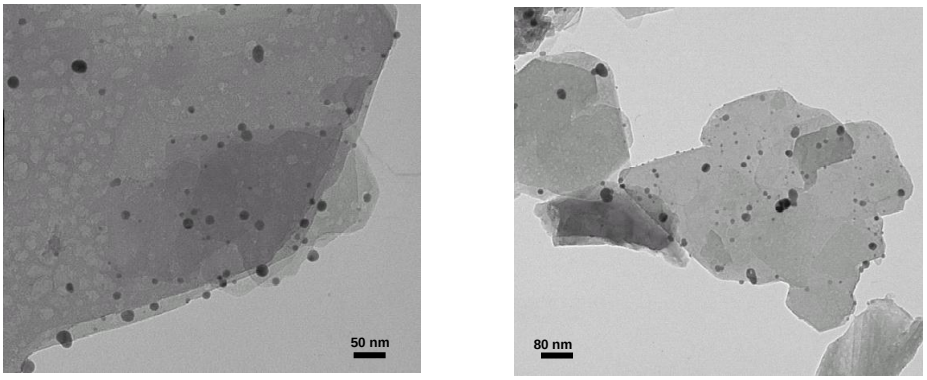

Figure 2. TEM micrographs of the sample chemically reduced