

## Structural and optical properties of Ag/SiO<sub>2</sub> nanocomposites

*Z. Nouicer<sup>1</sup>, M.L. Hioull<sup>1,2</sup>*

<sup>1,2</sup>Laboratory of Microstructures and Defects in Materials, Frères Mentouri-Constantine 1 University, Constantine, Algeria  
<sup>2</sup>Oum El Bouaghi University, Algeria

### Abstract

In this work, Ag/SiO<sub>2</sub> composites were studied for various silver contents (2.5, 5, 7.5 and 10% wt). In a first step, Ag<sup>+</sup> ions were adsorbed on silica by ionic exchange. In a second step, the samples were annealed in air at several temperatures (100-700° C). Several experimental techniques (SEM, XRD, FTIR, UV-Visible) were used to characterize the samples.

After ionic exchange, XRD revealed the presence of several silicate phases (Ag<sub>2</sub>Si<sub>2</sub>O<sub>5</sub>; Ag<sub>2</sub>SiO<sub>3</sub> and Ag<sub>3</sub>Si). After heat treatment, for a 5% wt Ag content, silver silicates (Ag<sub>4</sub>SiO<sub>4</sub>; Ag<sub>6</sub>Si<sub>2</sub>O<sub>7</sub>; Ag<sub>10</sub>Si<sub>4</sub>O<sub>13</sub>) and Ag phase were identified by XRD. All of the observed phases were nanosized.

FTIR spectra of Ag/SiO<sub>2</sub> present five bands in the region 400 to 2000 cm<sup>-1</sup> assigned to the vibration of Si-O-Si, Ag-O, Ag-SO<sub>4</sub>, Si-O and Si-OH groups. The increase of the silver content causes an overlap of Si-O and Si-OH peaks. A shift of the FTIR spectrum toward the low wave numbers was observed after annealing at 200° C. For high temperatures (300-700° C), the spectrum was moved in the opposite direction. This correlates with the formation of silver nanoparticles.

The UV-visible absorption spectrum of Ag/SiO<sub>2</sub> nanocomposites presents a wide band situated between 300 to 370 nm. This absorption was attributed to the surface plasmon resonance of Ag<sub>n</sub> clusters. After heat treatment, a shift of this band to the blue is observed, which correlates with the formation of larger silver nanoparticles.

**Keywords:** Nanocomposites, Silver, Silica, SiO<sub>2</sub>, Ag/SiO<sub>2</sub>