Structural and optical properties of $Ag/Si0_2$ nanocomposites

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Abstract

In this work, Ag/SiO_2 composites were studied for various silver contents (2.5, 5, 7.5 and10% wt). In a first step, Ag^+ ions were adsorbed on silica by ionic exchange. In a secondstep, the samples were annealedin air at several temperatures (100-700° C). Several experimentaltechniques (SEM, XRD, FTIR, UV-Visible) were used to characterizethe samples.

After ionic exchange, XRD revealed the presence of several silicate phases ($Ag_2Si_2O_5$; Ag_2SiO_3 andAg_3Si). After heat treatment, for a 5% wt Ag content, silver silicates (Ag_4SiO_4; $Ag_6Si_2O_7$; $Ag_{10}Si_4O_{13}$) and Ag phase were identified by XRD. All of the observed phases were nanosized.

FTIR spectraof Ag/SiO_2presentfivebandsin the region400 to 2000cm^{-1}assigned to thevibration of Si-O- Si, Ag-O, Ag-SO_4, Si-O andSi-OH groups.The increaseofthesilvercontentcausesan overlap ofSi-O andSi-OH peaks. A shift of the FTIRspectrumtoward the lowwave numberswas observedafter annealing at200° C.For highertemperatures(300-700° C), thespectrumwas moved inthe opposite direction.This correlates withthe formation of silver nanoparticles.

TheUV-visibleabsorptionspectrumof Ag/SiO_2nanocomposites presentes awideband situated between 300 to370 nm. This absorptionwas attributed to thesurface plasmonresonance of Ag_n clusters. After heat treatment, a shiftof this bandtotheblueisobserved, which correlates with the formation of larger silver nanoparticles.

Keywords:Nanocomposites, Silver, Silica, SiO_2,Ag/SiO_2