In-situ Formation of Silver Nanoparticles within Amphiphilic Graft Copolymer Template Film

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$AgBF_4$ or $AgNO_3$, dissolved in amphiphilic film of poly((oxyethylene)$_9$ methacrylate)-graft-poly((dimethyl siloxane)$_n$methacrylate), POEM-g-mPDMS. The formation of silver nanoparticles created in situ in the graft copolymer film was confirmed by transmission electron microscopy (TEM), UV-visible spectroscopy and wide angle x-ray scattering (WAXS). The results demonstrated that the use of $AgBF_4$ allowed for yielding silver nanoparticles with a small size (~5nm) and narrow particle distribution compared to $AgNO_3$. The behavior for the formation of silver nanoparticles was explained in terms of the interaction strength of the silver ions with the ether oxygens of POEM, revealed by differential scanning calorimetry (DSC) and x-ray photoelectron spectroscopy (XPS). DSC and small angle x-ray scattering (SAXS) data also showed the selective incorporation and the in situ reduction of the silver ions within the hydrophilic POEM domains. The excellent mechanical properties of the nanocomposite films (3~5x105 dyne/cm^2) were observed, mostly due to the confinement of silver nanoparticles in POEM chains as well as the interfaces created by the microphase separation of the graft copolymer film.