ABSTRACT

The present research work reports chemical synthesis of Ag-PVA nanocolloids, free-standing Ag-PVA nanocomposite films, and stable Ag-nanopowders (in support of carbon) and their characterization in terms of microstructure, X-ray diffraction, XPS, IR spectra, and optical and electrical/dielectric properties. A simple $Ag^{+} \rightarrow Ag$ reaction of a silver salt, such as $AgNO_3$, with reactive polymer molecules of poly(vinyl alcohol), PVA, of refreshed surfaces in an aqueous medium (hot) is developed and explored to synthesize shape controlled Ag-nanoparticles embedded in part of PVA molecules in an in-situ chemical method of synthesizing metal-polymer hybrid nanocomposites.

The results and analyses are presented with discussion in six chapters. Chapter-I gives a general introduction about the subject, reviews of the methods for synthesis of metal-polymer composites, and their typical properties and applications. Chapter-II describes experimental methods used in this work and the X-ray diffraction, microstructure, and other analytical methods applied in part of the characterization. Chapter III deals with analysis of the formation processes of Ag-PVA nanocolloids, nanocomposite films, and Ag-nanopowders. The Ag-contents in the colloids and films have been varied in steps as 0, 0.1, 0.2, 0.5, 1.0, 2.0 and 5.0 wt% in an attempt to develop useful properties for color pigments, optical materials and other applications. Thermal stabilities of Ag-PVA nanocomposites are described with TG-DTA thermal studies in Chapter IV. The electronic structure of the Ag-PVA nanocomposites is studied in terms of XPS bands of Ag-nanoparticles and those of the carbon and oxygen from PVA molecules in the matrix or in the Ag-PVA surface interfaces. Part of PVA molecules is coating Ag-nanoparticles in a kind of core shell structure. Studies of microstructure, XRD, electron diffraction, and optical and electrical /dielectric properties in the various samples are described in Chapters V-VII. A summary of the work with salient features achieved in this work is briefed in the last Chapter VIII along with a future scope of the work in this series. The both Ag-PVA nanocolloids and films as well as the Ag-nanopowders are light-emitting with strong charge transfer and/or SPR bands in the 300-800 nm range depending on the shape and size of the Ag-nanoparticles.

Keywords: Nanocomposites, Microstructure, Optical properties, Electrical properties, Dielectrics.