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Rahul Singhal, P. Sharma, R. Vishnoi, D.K. Avasthi

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Synthesis and Characterization of Au-C_{60} Nanocomposite

Rahul Singhal[1,*], P. Sharma[1], R. Vishnoi[1], D. K. Avasthi[2]
[1]*Malaviya National Institute of Technology Jaipur, JLN Marg, Jaipur- 302017, Rajasthan*
[2]*Amity University, Sector 125, Noida, U.P.*

Abstract

Au-C_{60} nanocomposite thin film (Au nanoparticles embedded in fullerene C_{60} matrix) is synthesized by thermal co-evaporation method and subsequent thermal annealing from 150˚C to 300˚C. A very small concentration of Au (~ 2 at.%) is chosen in order to minimize the deterioration of the physical and chemical properties of fullerene C_{60} due to the presence of metal. Spherical shaped Au nanoparticles with a diameter of 2.1 ± 0.04 nm are clearly seen in the TEM images of the nanocomposite annealed at 200˚C. A broad surface plasmon resonance peak at ~ 581 nm emerges in UV-visible absorption spectrum due to the evolution of Au nanoparticles at a temperature of 250˚C, which is further blue shifted at ~ 554 nm with a narrower FWHM at 300˚C. The presence of Au nanoparticles is also confirmed by X-ray diffraction with Au (111) and Au (200) fcc reflections. Thermally induced transformations of fullerene C_{60} matrix at high temperatures is studied by Raman spectroscopy on pure fullerene C_{60} films (without metal). The blue shift of LSPR at a temperature of 300˚C is ascribed to the transformation of fullerene C_{60} matrix into amorphous carbon and is explained in terms of Mie theory. TEM results show the growth of Au nanoparticles in fullerene matrix at higher temperatures due to the enhanced diffusion of Au atoms and Ostwald ripening.

Keywords: LSPR, nanoparticles, fullerene, optical properties

1. Introduction

Fullerene is a well recognized material and a key topic for scientific community that is being used for tremendous applications in different fields such as in biomedical, optical devices, hydrogen storage, energy conserving devices etc due to its various attractive properties of high electron affinity, unique molecular size, high reactivity, optical limiting and biological activity [1-4]. Several groups are working on this material to exploit it for diverse applications. In order

* Corresponding Author: Email: rsinghal.phy@mnit.ac.in