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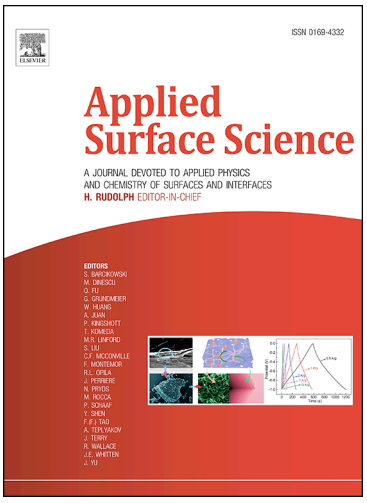

Full Length Article

Synthesis and Modification of Cu-C_{70} Nanocomposite for Plasmonic Applications

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ACCEPTED MANUSCRIPT

Synthesis and Modification of Cu-C_{70} Nanocomposite for Plasmonic Applications

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Abstract

Low energy ion irradiation is an interesting tool to accomplish the bulk modifications of different materials. The impact of low energy ion bombardment is studied on Cu-C_{70} nanocomposite thin films prepared by thermal co-deposition technique. A beam of 180 keV Ar ions was used for this purpose which results in a drastic change in structural, optical and electrical properties. It is demonstrated that surface plasmon resonance (SPR) was successfully induced with ion irradiation initially at a fluence of 3 x 10^{14} ions cm^{-2} and is observed to be first red shifted and then blue shifted on increasing fluence of ion irradiation. The results of Raman spectroscopy reveal the progressive transformation of fullerene C_{70} into amorphous carbon with fluence. The I(D)/I(G) ratio is calculated to analyze amorphous carbon and improved ordering of amorphous carbon at higher fluences is observed. TEM images verified the continuous growth of copper nanoparticles subjected to low energy ion irradiation with increasing fluence which is ascribed to the agglomeration of particles as pointed by EDS mapping images. FTIR results show that the destruction of fullerene C_{70} matrix is initiated at a fluence of 3 x 10^{14} ions cm^{-2}, which coincides with the appearance of SPR band. The transformation of fullerene into amorphous carbon and the growth of copper nanoparticles was found to be responsible for increase in conductivity with fluences as confirmed by I-V measurements.

Keywords: Low energy ion irradiation, noble metal nanoparticles, surface plasmon resonance, fullerenes.

1. INTRODUCTION

Plasmonics is an emerging sub-field of nanotechnology captivating the world of researchers. Among plethora of nanostructures, noble metal (Au, Ag, Cu) nanoparticles particularly have intriguing optical properties because of their photosensitivity and large extinction cross section [1-4]. These metal nanoparticles show characteristic absorption peak which is known as SPR peaks [5-9] which is due to the collective oscillations of the electronic cloud on metal nanoparticles and when the frequency of their vibration matches with the frequency of the e-m field, a large amount of energy is transferred from field to metal nanoparticles. The Au and Ag nanoparticles have been widely used for the plasmonic applications owing to their sharp SPR

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