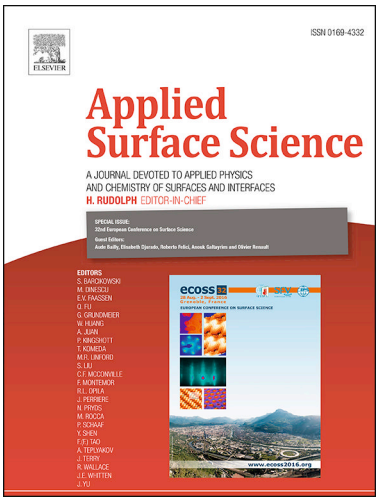

Full Length Article

Electronic excitation induced modifications in elongated iron nanoparticle encapsulated multiwalled carbon nanotubes under ion irradiation

V. Saikiran, P. Bazylewski, I. Sameera, Ravi Bhatia, A.P. Pathak, V. Prasad, G.S. Chang

PII: S0169-4332(17)33777-7
DOI: https://doi.org/10.1016/j.apsusc.2017.12.183
Reference: APSUSC 38053

To appear in: *Applied Surface Science*

Received Date: 25 July 2017
Revised Date: 19 November 2017
Accepted Date: 20 December 2017

Please cite this article as: V. Saikiran, P. Bazylewski, I. Sameera, R. Bhatia, A.P. Pathak, V. Prasad, G.S. Chang, Electronic excitation induced modifications in elongated iron nanoparticle encapsulated multiwalled carbon nanotubes under ion irradiation, *Applied Surface Science* (2017), doi: https://doi.org/10.1016/j.apsusc.2017.12.183

Electronic excitation induced modifications in elongated iron nanoparticle encapsulated multiwalled carbon nanotubes under ion irradiation

V. Saikiran[1*,#], P. Bazylewski[2], I. Sameera[3], Ravi Bhatia[4], A. P. Pathak[1], V. Prasad[3], G. S. Chang[2]

[1]School of Physics, University of Hyderabad, Hyderabad, India

[2]Department of Physics and Engineering Physics, University of Saskatchewan, Saskatoon, Canada

[3]Department of Physics, Indian Institute of Science, Bangalore, India

[4]Department of Physics, Panjab University, Chandigarh, India

Abstract

Multi-wall carbon nanotubes (MWCNT) filled with Fe nanorods were shown to have contracted and deformed under heavy ion irradiation. In this study, 120 MeV Ag and 80 MeV Ni ion irradiation was performed to study the deformation and defects induced in iron filled MWCNT under heavy ion irradiation. The structural modifications induced due to electronic excitation by ion irradiation were investigated employing high-resolution transmission electron microscopy, micro-Raman scattering experiments, and synchrotron-based X-ray absorption and emission spectroscopy. We understand that the ion irradiation causes modifications in the Fe nanorods which result in compressions and expansions of the nanotubes, and in turn leads to the buckling of MWCNT. The *G* band of the Raman spectra shifts slightly towards higher wavenumber and the shoulder $G^{'}$ band enhances with the increase of ion irradiation fluence, where the buckling wavelength depends on the radius '*r*' of the nanotubes as $exp[(r)^{0.5}]$. The intensity ratio of the *D* to *G* Raman modes initially decreases at the lowest fluence, and then it increases with the increase in ion fluence. The electron diffraction pattern and the high resolution images clearly show the presence of ion induced defects on the walls of the tube and encapsulated iron nanorods.

Keywords: MWCNT; Ion irradiation; Electronic excitation; Raman scattering; XAS; XES;

Email for correspondence: [*]*saivadavalli@gmail.com (V. Saikiran)* [#]**Presently at** *Department of Electronics and Physics, Institute of Science, GITAM University, Visakhapatnam-530045, AP, India.*