Noble metal-polymer nanocomposites as plasmonics and optoelectronics

Y. K. Mishra,[1*] S. Jebril,[1] D. C. Agarwal,[2] V. S. K. Chakravadhanula,[3] V. Zaporojtchenko,[3] D. K. Avasthi,[2] R. Adelung[1] and F. Faupel[3]

[1]Functional Nanomaterials, Institute for Materials Science, Faculty of Engineering, Christian-Albrechts-University, Kaiserstraße 2, 24143 Kiel, Germany.
[2]Inter University Accelerator Centre, Post Box -10502, New Delhi -110067, India
[3]Chair for Multicomponent Materials, Institute for Materials Science, Faculty of Engineering, Christian-Albrechts-University, Kaiserstraße 2, 24143 Kiel, Germany.

ABSTRACT

Dielectric matrices embedded with noble metal nanoparticles/nanostructures have attracted immense research interest due to their functional applications ranging from biomedical to optoelectronics. Polymer matrices are particularly suitable because of their low dielectric constants and high flexibility. In this work we report the synthesis of Ag and Au nanoparticles in different polymer matrices polyethylene terephthalate and polyimide) using atom beam co-sputtering technique. The nanocomposites with varying metal fractions were characterized by optical absorption, transmission electron microscopy (TEM) and I-V measurements. Optical absorption studies revealed tunable and broad surface plasmonic resonant absorption with varying metal fractions. Microstructural evolutions of nanocomposite films using TEM, confirmed the formation of spherical and irregular shaped nanoparticles and adjoined network of nanostructures. The chemical composition of sputtered polymer and nanocomposite films were investigated by X-ray photoelectron spectroscopy. Nanocomposites exhibit narrow transmission of UV light which could be of interest in designing filters whereas the extended broad plasmonic absorption make them to be the suitable candidates for solar absorbers. The current-voltage measurement shows that the gold-polymer nanocomposite exhibits photoswitching response with respect to UV-light.

***Corresponding Author**

Dr. Y. K. Mishra
Humboldt Research Fellow
Functional Nanomaterials
Institute for Materials Science
Faculty of Engineering, CAU Kiel
Kaiserstraße 2, 24143 Kiel, Germany
Email: ykm@tf.uni-kiel.de
Tele-Ph: +49-431 880 6195
Tele-Fax: +49-431-880-6229