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Optical characterization of nanocomposite polymer formed by ion implantation of boron

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Abstract

The boron-ion-implanted polymethylmethacrylate (B:PMMA) samples formed with an energy of 40 keV, ion doses ranging from 6.25 × 1014 to 2.5 × 1016 B+/cm2, and current density of <2 μA/cm2 were examined using UV–Vis spectroscopy. The gradual increase of absorbance at lower fluences (<1016 B+/cm2) and their saturation at higher fluences (>1016 B+/cm2) in the course of ion-induced carbonization are observed. The value of optical band gap energy of boron-ion-implanted layer Egopt,B was estimated given thickness of implanted layer as a maximum penetration depth of B+ ions into PMMA by slow positron beam spectroscopy in agreement with SRIM simulation results. On the basis of Egopt,B values, a number of carbon atoms in carbonaceous clusters N for the B:PMMA was calculated. It is found the existence of three regions of ion doses (1) 6.25 × 1014 ÷ 3.13 × 1015 B+/cm2, (2) 3.75 × 1015 ÷ 6.25 × 1015 B+/cm2, and (3) 1.25 × 1016 ÷ 2.5 × 1016 B+/cm2, showing thresholds in the estimated Egopt,B and N values as a function of ion dose for the B:PMMA studied. The ion-induced structural evolution towards formation of carbon nanostructures within these thresholds is suggested as explanation of experimental results, taking into account the possible carbonization in high-dose B:PMMA nanocomposite films.

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