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Ion Beam Induced 2D Mesophase Patterning of Nanocrystallites in Polymer

Authors : Srutirekha Giri, Manoranjan Sahoo, Anuradha Das, Pravanjan Mallick, Biswajit Mallick

Abstract : Ion Beam (IB) technique is a very powerful experimental technique for both material synthesis and material modifications. In this work, 3MeV proton beam was generated using the 3MV Tandem machine of the Institute of Physics, Bhubaneswar and extracted into air for the irradiation-induced modification purpose[1]. The polymeric material can be modeled for a three-phase system viz. crystalline(I), amorphous(II) and mesomorphic(III). So far, our knowledge is concerned. There are only few techniques reported for the synthesis of this third-phase(III) of polymer. The IB induced technique is one of them and has been reported very recently [2-4]. It was observed that by irradiating polyethylene terephthalate (PET) fiber at very low proton fluence, 10^{10} - 10^{12} p/s, possess 2D mesophase structure. This was confirmed using X-ray diffraction technique. A low-intensity broad peak was observed at small angle of about $2\theta = 6^{o}$, when the fiber axis was mounted parallel to the X-ray direction. Such peak vanished in the diffraction spectrum when the fiber axis was mounted perpendicular to the beam direction. The appearance of this extra peak in a particular orientation confirms that the phase is 2-dimensionally oriented (mesophase). It is well known that the mesophase is a 2-dimensionally ordered structure but 3-dimensionally disordered. Again, the crystallite of the mesophase peak particle was measured about 3nm. The MeV proton-induced 2D mesophase patterning of nanocrystallites (3nm) of PET due to irradiation was observed within the above low fluence range and failed in high proton fluence. This is mainly due to the breaking of crystallites, radiation-induced thermal degradation, etc.

Keywords : Ion irradiation, mesophase, nanocrystallites, polymer
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