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Modification the surface properties of polyethylene by high energy ion beam

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ABSTRACT

At present, modifying the properties of polymeric materials due to their wide use for high technology applications is strongly required. Polyethylene (PE) samples were treated with 9 MeV Cl ions to the fluences ranging from 1×10^{13} to 5×10^{14} cm^{-2}. Photoluminescence (PL), Fourier transform infrared spectrometer (FTIR) and UV–vis spectroscopy techniques were used to study the untreated and treated samples. The obtained results exhibited minimize in integrated luminescence intensity with the increase of ion fluence. This decrease is attributed to formation of defects in treated samples. FTIR spectral studies indicate that the ion beam induces compositional transformation within the treated samples. The UV measurements show a shift towards the visible region and an increase in the optical absorption for all bombarded samples. This change may be referred to damage of polymer surface and/or formation of −C=C– bonds, which decreases the band gap energy and Urbach's energy of treated samples.

1. Introduction

Nowadays, polymers have gained much importance in many fields of science and technology. This is due to their dazzling properties such as chipper, resist corrosion, optical Clarity …. ..etc. However, despite these wonderful properties, their direct use in many optical and electrical devices is still limited due to the high electrical resistance of their surfaces. Therefore, improve the physico-chemical properties of polymers surface at this time for high technology applications is so required. Many methods have been applied to amend the characteristics of polymers like plasma deposition (Pei et al., 2012; Perni et al., 2012), surface etching by chemicals (Saad et al., 2014), electron beam (Hooshangi et al., 2015; Wu et al., 2013; Czaja and Sudol, 2011), gamma ray irradiations (Raghuvanshi et al., 2012; Yao et al., 2014; Forster et al., 2013), UV-light (Sheela et al., 2014) and ion bombardment (Singh et al., 2014; Park et al., 2008; Fasce et al., 2010; del Grosso et al., 2008). Among these techniques, ion beam technology seems to be a very hopeful technique for modifying the surface characteristics of polymers. This beneficiary of ion beam refers to its high deposited energy into the material and readily adjustable permeation depth (Abdul-Kader et al., 2005a). Irradiation of polymers by ion beams leads to change in the surface properties (Clough, 2001; Hazarik et al., 2012; Abdul-Kader, 2009; Siddhartha et al., 2012; Kumar et al., 2012; Šiljegović et al., 2011; Abdel Moez et al., 2012; Qureshi et al., 2009; Verma et al., 2012; Radwan et al., 2008; Zenkiewicz and Kurcok, 2008; Rosu et al., 2009). This change refers to breaking of chemical bonds and ultimately escapes of hydrogen atoms from treated samples that leading towards the formation of cross-linking and chain scission into bombarded materials (Abdul-Kader et al., 2005a). Moreover, the ion beam bombardment can significantly improve the surface characteristics of the polymers without any alteration underneath the ion range into the modified samples. The use of the polymeric materials in an invention of premium capacitors and organic light emitting diodes justifies the need for investigating the influence of ion beams on the optical parameters of polymers such as absorption and optical energy gap (Pejova et al., 2004). Polyethylene (PE) is considered as one of the most important polymers that have been utilized in many applications. This importance of PE refers to its versatile properties such as high erosion resistance and comparatively low cost. In spite of such features, the bad conductivity nature of PE results in the agglomeration of static charges on its surface. The polymeric materials that have good electrical conductivity are more attractive to the bio-engineering and micro-electronics technology. This requirement motivates us to search about the new technique to decrease the energy gap of the surface, that means an intension in the surface conductivity of this polymer to become suitable for technological applicable in different biomedical applications and optoelectronic devices.

In this work, we have concentrated on the impact of the high-energy ion beam on the surface properties of PE; this is due to that the thicker treated layers would be useful for a plurality of applications. This work

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