Abstract

Polyamide-6,6 (PA66) has been modified by three distinct means: (a) Electron beam modification of PA66 specimens, (b) In situ silica (by sol-gel technique) modification of PA66 matrix and (c) unfunctionalized multiwalled carbon nanotubes (u-MWCNTs) and amine-functionalized multiwalled carbon nanotubes (f-MWCNTs) incorporated in PA66. Broadly speaking, the last two methods are simply the modification of PA66 by nanofillers while the first method is the generation of covalent crosslinks at the nanolevel.

Electron beam modification of the PA66 specimens (injection-molded tensile dumbbells and compressive test cylinders and compression-molded films) reveal that 200 kGy is the optimum radiation dose based on extensive property studies like mechanical, dynamic mechanical and water absorption. The properties deteriorate at 500 kGy radiation dose. The explanations have been substantiated with gel content, X-ray and differential scanning calorimetry studies. The notable achievement of this study was that the tensile strength, modulus, compressive stress relaxation behavior and water absorption tendencies of pristine PA66 improved without the use of any filler, which would definitely lead to savings in terms of product weight and cost.

The effect of silica nanophase grown in situ within PA66 matrix has been explored in thin films in terms of spectroscopic, morphological, thermal, mechanical, dynamic mechanical and water-uptake changes. The properties were correlated with the structure of the silica based PA66 nanocomposites.

A comparative study of the u-MWCNTs and f-MWCNTs incorporated in PA66 films has been reported in terms of morphological, thermal, mechanical, dynamic mechanical and water absorption results. Further, direct amination of the MWCNTs has been done for the first time with hexamethylenediamine as the organic amine.

The radiation work was further extended to the nanofiller-modified PA66 systems for exploring the structural and property effects as a result of electron beam

irradiation in air in presence of the in situ generated sol-gel silica and the nanotubes dispersed within the PA66 matrix. Thermogravimetric analysis of neat PA66, PA66 crosslinked by radiation and PA66 modified by nanofillers were carried out to explore the activation energy trends and thermal decomposition traits of these novel materials.

Keywords: Polyamide-6,6; Electron beam irradiation; Injection molding; Compression molding; Tetraethoxysilane; Multiwalled carbon nanotubes; Nanofillers; Nanocomposites; Sol-gel technique.