ELSEVIER

Nuclear Instruments and Methods in Physics Research B 185 (2001) 248–253

NIM B
Beam Interactions with Materials & Atoms

www.elsevier.com/locate/nimb

Surface reliefs on diacrylate monomer films by spatially controlled UV photopolymerization

G. Gozzelino [a,*], S. Liturri [a], G. Audisio [b]

[a] *Dip. Scienza dei Materiali e Ing. Chimica, Politecnico di Torino, 10129 Torino, Italy*
[b] *Ist. Chimica delle Macromolecole del CNR, Via Bassini 15, 20133 Milano, Italy*

Abstract

The non-uniform ultraviolet (UV) photopolymerization of acrylic films allows the formation of surface reliefs through a self-developing process. The parameters that influence the growth of the reliefs for polymer films made of bis-phenol-A-diglycidil-ether diacrylate (BGEDA), an aliphatic polyurethane diacrylate and an aromatic polyurethane diacrylate, mixed with tri-propylen-glycol diacrylate as promoter, have been investigated. The results show that the time of photopolymerization, the after-curing self-developing time, the mixture composition and the polymer film thickness influence the relief development in a complex way. The behaviours of the different monomers were explained on the basis of two main factors: the properties of the polymeric network and the diffusion phenomena which take place in the polymer bulk.

Keywords: UV photopolymerization; Diacrylate; Films; Surface relief; Networks

1. Introduction

Ultraviolet (UV)-induced polymerization is a chemical process that is widely used to obtain cross-linked polymeric films with industrial applications in many fields, mainly for the production of coatings, adhesives and electronic devices [1]. The basic advantages of UV-induced polymerization are the very fast reaction, the absence of solvents and the possibility of controlling the physical and chemical properties of the cross-linked film through the selection of a suitable mixture of monomers and/or oligomers containing UV reactive functional groups. Moreover, the possibility of obtaining and controlling a relief formation process, which is self-developing after the irradiation step under conditions of non-uniform cross-linking of the polymer film, can extend the application of UV photopolymerization to new technological fields such as holography, data storage and processing, diffractive optics and microoptics [2].

A UV curable resin film submitted to irradiation through a mask which controls the UV spatial distribution on the film surface develops a non-uniform conversion of the reactive functional groups in the bulk of the film and a mass transport occurs between sections with different levels of monomer conversion. As a consequence a localized swelling

* Corresponding author.
E-mail address: gozzelin@fenice.polito.it (G. Gozzelino).

0168-583X/01/$ - see front matter
PII: S0168-583X(01)00761-3