## Polymer Networks with Antibacterial Activity by UV Photopolymerization

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**ABSTRACT:** The crosslinking by radical UV photopolymerization of mixtures of acrylic oligomers added with 2,4,4'-trichloro-2'-hydroxydiphenyl ether (TCDPE) allows to obtain polymer films which perform like hygienic coatings. The release of the bioactive compound from two types of acrylic networks obtained by UV crosslinking of polyfunctional monomers, namely, epoxy-based and urethane-based diacrylic oligomers, has been investigated. The photopolymerization process was influenced by biocide presence only at high biocide concentration, where the plasticizing effect of the biocide increased the double bond conversion. The kinetic curve of the photopolymerization was fitted by an Avrami-like equation and the release of TCDPE from the networks into solu-

## **INTRODUCTION**

Synthetic macromolecules are suitable materials for the production of functional coatings able to control active molecule release for pharmaceutical<sup>1</sup> or hygienic<sup>2</sup> purposes. The coatings perform as functional coatings when they contain additives which can be released on the surface or into the surrounding environment to develop a specific activity. Additives with biocide activity can generate hygienic coatings when the biocide released from the bulk on the surface or into the surrounding medium reaches a concentration higher than minimum inhibitory concentration toward pathogen microorganisms.

A fast way to obtain functional coatings is to use the UV photopolymerization to form networks that contain the active substance dissolved in the crosslinked polymer. Besides the advantage of the intrinsic insolubility of the crosslinked polymer in the contacting liquids, there is the opportunity to modulate the swelling behavior that controls the diffusion rate and the release of specific active molecules. The tions of ethanol–water of different compositions was discussed on the base of the Fick's diffusion equation. The antimicrobial activity of the UV photopolymerized film has been tested by putting the coatings in contact with two types of colony-forming bacteria, the *Escherichia coli* (Gram negative) and the *Staphylococcus aureus* (Gram positive). Strong hygienic performances toward the tested pathogens were observed for the urethane and epoxy films containing TCDPE in quantities as low as 0.1 wt %. © 2009 Wiley Periodicals, Inc. J Appl Polym Sci 112: 2334–2342, 2009

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swelling extent is influenced by the crosslink density and, in relation with the composition of the liquid contacting the polymer film, by the network chemical composition.

When UV photopolymerization is used to generate a functional crosslinked coating further benefits should be taken into account: the very fast conversion of the liquid into a solid, the easiness to copolymerize different monomers to obtain structures with designed properties, and a friendly system without volatile solvents that could be released in the environment.

The physical and chemical properties of the crosslinked film can be controlled through the selection of a suitable mixture of monomers and/or oligomers, the only limitation being the required presence of UV reactive chemical groups, namely, acrylic or methacrylic groups for polymerizations started by UV initiators with radical mechanism of action.<sup>3</sup>

In this article, we report about the use of acrylic bifunctional monomers, namely, diacrylic compounds based on epoxy or urethane oligomers, to obtain epoxy or urethane networks with different structure and crosslink density, containing a biocide able to hinder the growth of bacteria through inhibition or destruction of living cells.

At the present time, the hygienic performance of an antimicrobial agent present in a polymer matrix cannot be easily predicted or controlled. There is a

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