ACRYLATED VANILLIN-BASED PHOTOCROSS-LINKED POLYMERS

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Photopolymerization engendered high interest both in academia and in industry due to the considerable practical and economic benefits. Photopolymerization have the advantages of rapid cure, low energy consumption, high efficiency, low volatile organic compound emission, and the large number of applications in not only conventional areas such as coatings, inks, and adhesives, but also in high-tech domains, such as microelectronics, optoelectronics, laser imaging, stereolithography, and nanotechnology [1]. The renewable feedstock use in materials production using photopolymerization processes reveals the great potential of renewable raw molecules and their ability to replace petroleum-based materials. Recently, vanillin and its derivatives have attracted much attention as renewable building blocks for high performance polymers mainly because of their rigid aromatic structures. Synthetic vanillin from lignin or guaiacol is more commonly available, however it can be extracted from natural sources as well. With its functionalities and large-scale availability, vanillin is an ideal scaffold for monomer synthesis [2].

In this study, the cross-linked polymers were obtained by photopolymerization of vanillin diacrylate or vanillin dimethacrylate with 1,3-benzenedithiol using ethyl (2,4,6-trimethylbenzoyl) phenyl phosphinate as photoinitiator. The chemical structure of the photocross-linked polymers was confirmed by IR spectroscopy. The yield of the insoluble fraction of the photocross-linked polymers obtained after Soxhlet extraction with acetone for 24 h was in the range of (87-95) %. Thermal and mechanical properties of vanillin diacrylate- and vanillin dimethacrylate-based photocross-linked polymer films were investigated and compared.

It was established by differential scanning calorimetry that the photocross-linked polymers of vanillin diacrylate and vanillin dimethacrylate were amorphous materials with the glass transition temperature of -5 ºC. Their thermal degradation temperatures at the weight loss of 10 %, determined by thermogravimetric analysis, were 270 ºC and 240 ºC, respectively.

Mechanical testing of the photocross-linked polymers was performed by tensile test on a BDO-FB0.5TH (Zwick/Roell) testing machine. The mechanical characteristics of obtained vanillin diacrylate and vanillin dimethacrylate-based photocross-linked polymer films were following: tensile strength was 5 MPa and 25 MPa, the elongation at break was 31.4% and 0.5%, the Young modulus was 16 MPa and 2953 MPa, respectively.

It was determined that vanillin diacrylate-based photocross-linked polymer film is more rigid and mechanicaly stronger, whereas vanillin dimethacrylate-based photocross-linked polymer film is more soft and flexible.

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