NOVEL PHOTOCURABLE RESINS DEDICATED TO OBTAINING POLYMER NANOCOMPOSITES IN 3D-VAT TECHNOLOGIES

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Photoinduced polymerization is a photochemically initiated process utilizing a suitable light source emitting electromagnetic radiation in the ultraviolet (UV) to visible (VIS) range. Photopolymerization processes are now widespread and rapidly developing with technologies related to the molding of three-dimensional models employing light-initiated 3D printing and the printing industry, where they are commonly used for photo-curing UV varnishes and inks. In addition, an interesting application of photoinitiated 3D printing is its implementation for obtaining photo-curable polymer nanocomposites. Composite materials are a class of multifunctional materials that are very popular due to their favorable properties. Particularly worthy of attention are nanocomposite materials, in which the addition of nanofiller changes the final properties of the product, for example: improves its thermomechanical properties, increases its heat resistance, and provides conductive properties. The final properties depend on the selection of a suitable nanofiller, among which carbon nanotubes, silica, aluminum oxides, and natural and polymer fibers are widely used additives.

The present work concerns the study of pentafluorostilbene derivatives. We investigated the suitability of 10 1,2,3,4,5-pentafluoro-6-[(E)-styryl]benzene derivatives to behave as potential photosensitizers of the diphenyliodonium salt IOD to initiate radical, cationic, and hybrid photopolymerization processes applying light sources in the ultraviolet and visible range. The next step was to verify the possibility of obtaining photo-curable polymer nanocomposites using 3D printing technology.

The presented pentafluorostilbene derivatives demonstrate favourable absorption properties, especially in visible light, absorbed up to ~420-450 nm. Spectroscopic properties investigations of stilbene derivatives have shown that their absorption characteristics are compatible with the emission characteristics of light sources applied in DLP printers ($\lambda = 405$ nm). The examined compounds have very beneficial redox properties, which allows their use in two-component systems photoinitiating with iodonium salt to initiate radical, cationic, and hybrid photopolymerization utilizing a light source from both ultraviolet and visible range. According to a variety of spectroscopic, electrochemical, as well as kinetic studies, the most effective initiator system (M10+IOD) was selected, which in a further stage of research was employed for application research related to the preparation of photo-curable polymer nanocomposites using 3D-VAT technology. The high photoactivity of the M10+IOD system allowed its application as an efficient photoinitiating system for 3D-VAT printing of ZnO-nanocomposites using DLP technology.

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