The UV-induced polymerization of multifunctional monomers has found a large number of applications in various industrial fields, mainly in the production of films, inks and coatings on a variety of substrate, including paper, metal and wood. This polymerization process has been used for fabrication of nanostructured epoxy coatings characterized by outstanding properties, pursuing two different approaches, either a top-down or a bottom-up approach.

Via a top-down approach silica or titania nanoparticles were directly dispersed in the epoxy resin, followed by photocuring of the blends. A homogeneous distribution of the inorganic particles within the polymer matrix and a good interfacial adhesion between the two phases was achieved and attributed to a chain transfer mechanism involving hydroxyl groups present on the surface of the fillers. Epoxy based nanocomposites with advanced and outstanding properties were obtained by carbon-nanotubes dispersion. An important increase of electrical surface conductivity was obtained in the cured materials. Via a bottom-up approach, a dual-curing process, which involved photopolymerization and subsequent hydrolysis and condensation reactions of alkoxysilane, alkoxytitanate or alkoxyzirconate groups, was used in order to prepare organic-inorganic nano-hybrid networks. TEM analysis indicated the formation of the inorganic phases at nanometer level, which induced an important improvement of the mechanical properties and thermal stability of cured networks. The use of zirconium tetrapropoxide as inorganic precursor induced a linear increase of the refractive index by increasing the precursor content in the photocurable formulation. An in situ synthesis of silver-epoxy or gold-epoxy nanocomposite was also achieved by simultaneous photoinduced electron transfer and cationic polymerization processes of epoxy formulations containing silver or gold salts as precursors.

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