Nanocomposites and nanomaterials

Enhancement of polymer endurance to UV light by incorporation of semiconductor nanoparticles

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Polymers are widely used materials in a large variety of commercial and technical application. Among a huge diversity of polymers, Polyvinyl alcohol (PVA) plays an important role in industrial application such as fiber and textile sizing, coating, adhesives, emulsifiers, film packaging of food etc. However, like all organic materials PVA is sensitive to UV light that is one of the major limitations for its use in exterior conditions.

In order to reduce the harmful effects of UV light two types of protectors could be used: i) non-colored organic UV absorbers that have an increased ability to absorb UV light with further transmitting UV energy to thermal one, ii) organic UV stabilizers – which molecules work as a radical scavengers and thus deactivate the products of photolysis. Recently, semiconductor nanoparticles were proposed as a new type of inorganic UV-absorbers.

In the present study we report the improvement of UV resistance of PVA to UV light by incorporation of CdS nanoparticles.

By applying optical characterization techniques we revealed the triple role of NPs in increasing resistance of PVA to UV. Firstly, the NPs absorb the UV light and the energy is partly converted into thermal energy via non-radiative processes within the NPs. Secondly, the UV energy absorbed by the NPs is partly re-emitted as a visible light via luminescence processes. By these two mechanisms a certain part of incident UV light is shielded by the filler and UV energy cannot anymore be absorbed by the bulk of the polymer. Thirdly, when the remaining part of UV flux interacts with the polymer and excites various defects, the NPs serve as the energy drains, thus deactivating excited groups. This slows down the formation of both new chromophore groups and free radicals, which can further react with atmospheric oxygen and alter the polymer properties. By all the above processes the excitation of polymer chains decreases and the probability of photo-chemical reactions in the polymeric part of the composite are diminished.