NIR-Sensitive Systems Comprising Cyanines Operating as Molecular Oven to Facilitate Photopolymerization in the Shadows and Physical Drying

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NIR-light mediated processes have received increasing interests due to its benefits of deeper penetration of excitation light into the samples compared to UV sensitive systems and the broader accessibility of working wavelength. Cyanines comprising variable structural patterns play vital role as light absorbers with broad absorption wavelength in near-infrared range between 700-1100 nm in photochemical reactions based on activated photoinduced electron transfer (**PET**). The technology of high-power NIR-LED prototypes was recently introduced to the photopolymerization systems promoting to overcome the internal activation barrier in the cyanine-comprising systems exhibiting a positive charge. Therefore, the combination of high-power NIR-LEDs and cyanines facilitates the process by dual initiation mechanism where initiating species (reactive short-living radicals and conjugate acid) formed, and heat generated from the cyanines contribute to polymer fabrication. The initiating systems comprising cyanines and iodonium salts carrying $N(SO_2CF_3)_2^-$ as counter ion showed significant efficiency to initiate radical polymerization using UDMA and 4-hydroxybutyl vinyl ether for cationic polymerization, respectively, as determined by real-time FTIR. Surprisingly, the heat generated from cyanines upon exposure also promotes the diffusion of the radicals formed by **PET** reaction between iodonium salt in the matrix using (meth)acrylates as monomers facilitating radical photopolymerization also occurring in the shadow resulting in formation of homogeneous polymer networks. The mechanical properties of the materials obtained in the shadow showed similar performance compared that from exposed areas, while the materials processed in an oven exhibited different behaviour. This again approves that the dual combination of photonic events and heat contributed to the materials properties in the shadow of the exposed object. Furthermore, such systems also facilitate the physical drying of coating dispersions for removal of water as a replacement of conventional oven techniques followed by radiation with either UV or NIR light for crosslinking. This ON/OFF process can be seen as a big benefit for energy saving.

References

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