Photoactive Polymeric Dormants: New Design of Functional Coatings with Nanostructured Domains via "Controlled" UV-Curing Process

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UV-curing process based on photo-induced radical polymerization has been widely utilized for inks, paints, adhesives, and photo-resist materials. Especially, facile tuning of UV intensity, wavelength, irradiation area etc, has enabled their industrial applications, however the precise control of photo-polymerization is not trivial due to their too rapid reaction time (within seconds). Delicate balance of reaction kinetics, deformation (shrinkage), and phase-separation associated to polymer network formation needs to be considered.

Reversible deactivation radical polymerization (RDRP) techniques such as atom-transfer controlled radical polymerization (ATRP) have greatly impacted the advancement of polymer synthesis in the last 20 years, allowing well-defined polymers with precise molecular weight distribution and segment blocks. Recently, further temporal (on/off) control of polymerization via external stimuli such as photo-excitation has proposed and gained increased attention. We have focused on organo-catalyzed iodine-mediated controlled radical polymerization and developed photoactive polymeric dormant with C-I endgroup. The polymeric dormant was utilized to the UV-curing process to give optically clear coatings with unique bicontinuous morphology with gradient size distribution. The nanodomains were evolved via polymerization-induced microphase separation (PIMS), and kinetically trapped by crosslinking. Here we design functional polymeric dormant to selectively functionalize the evolved nanodomains. Surface wettability and optical properties, etc was tunable with functional nanodomains. Hierarchical nanostructures with macro-/microphase-separated domains were also developed by our method, and potential applications will be also discussed.