Fe(II) Complexes and Biobased Monomers for Sustainable Photopolymerization under LED, Laser (Direct Laser Writing) and Sunlight

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Abstract

The use of light driven processes in chemical synthesis represents a powerful strategy toward greener and more sustainable technologies, enabling precise reaction control, reduced energy consumption, and mild operating conditions. This work focuses on the development of environmentally friendly photocatalysts based on Fe(II) complexes coordinated with phenanthroline derived ligands for applications in free radical photopolymerization (FRP) and cationic photopolymerization (CP). Iron is an attractive metal due to its natural abundance, low cost, low toxicity, and biocompatibility, providing a sustainable alternative to conventional systems. The phenanthroline framework allows structural tuning of photochemical properties and reactivity. Biobased monomers, including epoxidized soybean oil acrylate and sorbitol, are employed to enhance sustainability and enable renewable polymeric materials. Photocatalytic performance is evaluated under LED, laser, and sunlight irradiation using real time FTIR. The systems are further explored in Direct Laser Writing, enabling spatial and temporal control for the fabrication of complex microstructures. Photoinitiation mechanisms are used to understand the process and guide the design of high performance, sustainable photopolymerization systems.

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