SUSTAINABLE CURING BY PHOTOINDUCED FRONTAL POLYMERIZATION IN THE PRESENCE OF BIOFILLERS

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Frontal polymerization, characterized by a self-sustaining reaction triggered by an initial stimulus forming a localized reaction zone, referred to as the "polymerization front," is categorized into three types: thermal frontal polymerization, photoinduced frontal polymerization, and isothermal polymerization. The unique attributes of photoinduced frontal polymerization offer diverse applications not easily achievable with traditional batch processes, exhibiting superior time, energy, and cost efficiencies due to its rapid reaction rate and low energy input [1].

Despite these advantages, certain constraints exist. Photoinduced frontal polymerization requires highly reactive monomers for self-propagation, leading to unintended spontaneous polymerization in some monomer systems at or near ambient temperature. Another significant challenge is the effective mitigation of heat loss from the front to the surroundings. Furthermore, numerous polymerization motifs encounter issues such as undesired termination reactions or slow background gelation from a chemical perspective [1, 2].

In this work we present preliminary results on the curing of thick samples and samples buried in dark areas by photoinduced frontal polymerization of acrylic monomers (as sketched in Figure 1). The addition of natural fillers (e.g., wood powder and cellulose fibrils) was investigated. Characterization was performed by using FT-IR, UV-Vis and DMA instruments. In addition, the optimization of the process is discussed considering thermal effects, reaction mechanism, type of formulation, and environment and process conditions.

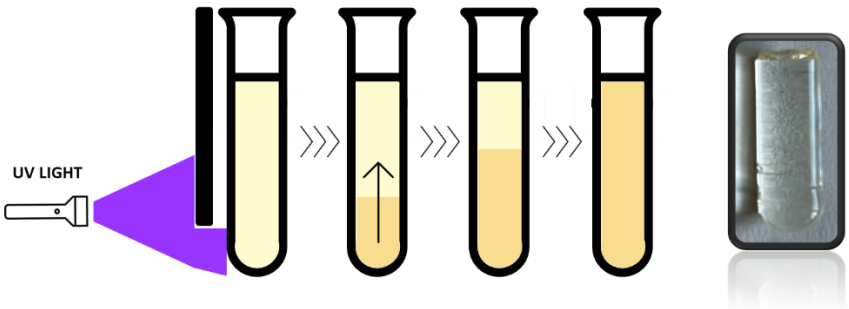

Figure 1. Photoinduced frontal polymerization process.

References

1. Benjamin A. Suslick et al, Chem. Rev., 123 (6), 3237–3298, 2023.
2. Odian, G., Principles of Polymerization, 4th ed. John Wiley & Sons, Inc.: Hoboken, NJ, 2004.

This project received funding from the #horizoneurope20212027 programme under the Marie Skłodowska-Curie Doctoral Networks (MSCA-DN) grant agreement No 101073432.

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Funded by the European Union