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Sustainable Adhesives by Photoinduced Frontal Polymerization Of Biobased Acrylates In The Presence Of Natural Fillers

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Frontal polymerization (FP) is a self-sustaining reaction triggered by an external stimulus, such as heat or light, that creates a localized reaction zone called the "polymerization front." The heat released in this exothermic process raises the temperature, enabling further polymerization at the boundary between the formed polymer and the unreacted monomer, often resulting in planar propagation [1]. Compared to traditional polymerization, FP is simpler, faster, and more efficient, requiring no stirring, fewer steps, minimal solvents, and no constant external energy, while ensuring uniform polymer structures and high conversion efficiency [2]. Photoinduced frontal polymerization offers several advantages over traditional thermal FP, primarily due to its ability to provide more precise spatial and temporal control over the reaction.

This study investigates the curing of reactive formulations in dark regions using photoinduced FP of biobased acrylic monomers. The influence of natural fillers, such as wood and cellulose powder, was analyzed. Characterization methods included FT-IR, viscometry, thermal imaging, and FESEM. Additionally, the study examined process optimization concerning thermal effects, frontal velocity, monomer conversion, reaction mechanisms, formulation composition, and environmental and processing conditions. The work demonstrates that the interaction between light and the monomeric system is crucial in tailoring the FP process and thus the material properties, as it allows for the selective activation of polymerization in specific regions. This tunability is particularly beneficial for developing advanced materials, such as high-performance biobased adhesives, where controlled curing, rapid processing, complex geometries, and enhanced mechanical properties are essential.

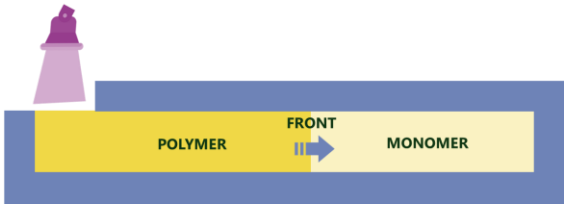


Figure 1. Schematic illustration of frontal polymerization.

References

[1] Benjamin A. Suslick et al, "Frontal Polymerizations: From Chemical Perspectives to Macroscopic Properties and Applications" *Chemical Reviews* Vol 123, 2023, 3237–3298.
[2] Li, Qing et al, "Advances in frontal polymerization strategy: From fundamentals to applications" *Progress in Polymer Science* Vol 127, 2022, 101514.

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