

# THE ROLE OF THERMAL MANAGEMENT IN THE RADICAL INDUCED CATIONIC FRONTAL POLYMERISATION OF COMPOSITES

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Frontal polymerisation as a strategy for the processing of fibre reinforced polymer (FRP) composites offers significant reductions in processing time and costs with lower environmental impacts compared to conventional Out-of-Autoclave (OoA) composite processing methods [1]. Frontal polymerisation of the industrially relevant epoxide monomers typically follows a Radical Induced Frontal Polymerisation (RICFP) mechanism; several recent reports demonstrated the possibility to produce FRPs via this mechanism [2-6]. Controlled RICFP is however complicated by the intrinsic low reactivity and high exothermicity of epoxide monomers. If the composition is not well controlled, this can result in a run-off of front temperatures over 250°C [7] and consequent thermal degradation or extensive foaming in the resulting polymer [8,9] in cycloaliphatic epoxide systems.

Variations in total heat and kinetics of reaction could be achieved by accurate choices of monomer [8] or photo- and thermal initiator contents [5,10]. Little attention has however been paid to the role of thermal management as a tool to control the governing heat balance in RICFP, which will be addressed in this talk. The choice of mould material was found to be of great influence on the chemical and mechanical properties of neat cycloaliphatic polymer and accurate thermal management allowed to produce a void-free and translucent polymer with thermo-kinetic properties closely matching the properties of thermally cured epoxide resins. The introduction new phases into the system such as highly conductive carbon fibres to produce carbon FRPs, required the heat generation and depletion to be balanced as a function of the fibre content, leading to the definition of a processing window. Carbon FRPs with volume fractions up to 51% were produced with optimal thermal management.

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