Frontal polymerisation of gelated polymer resins

**Project type:** Master semester project – Autumn 2023

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Frontal polymerisation has emerged as a promising alternative for processing of epoxide polymers and epoxide-based fibre reinforced composites, requiring only a fraction of the time and energy input compared to conventional thermal polymerisation (e.g. oven curing) [1]. The mechanism is based on an autocatalytic mechanism that can, after the application of an initial external trigger, form a self-sustaining polymerisation “front” (i.e. a distinct separation between hot, formed polymer and cold monomer resin as shown in Figure 1) that can subsequently progress through the part, allowing for nearly complete polymerisation in seconds to minutes. An example of the frontal polymerisation process can be found [here](#). Control of the local heat balance, i.e. the generated heat of polymerisation that is counterbalanced by thermal diffusion and heat losses to the ambient environment and potential inert second phases, has been identified as a crucial parameter for successful frontal polymerisation [2].

![Illustration of a propagating polymerisation front.](image)

**Figure 1 Illustration of a propagating polymerisation front.**

The LPAC is actively developing strategies that would enable the frontal polymerisation of FRP parts with high fibre contents. The development of gelated systems, i.e. in contrast to the conventional liquid resin systems, that can undergo frontal polymerisation is foreseen to bring additional benefits in the design of novel processes and is therefore subject of a semester project. The semester project comprises the development of a chemical composition capable of frontal polymerisation after initial thermal gelation, optimisation of the preparation process and characterisation of the resulting thermal properties. The exact project definition and workload can be further adjusted based on the student’s preferences.
