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Using Micro-CT in the Context of Self-healing Polymers

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ABSTRACT

This lecture will highlight a recent research effort of the Polymer Chemistry Research Group (UGent) in the area of autonomous self-healing polymers for which micro-CT was applied in collaboration with the Centre for X-ray Tomography (UGCT, UGent).

In this published research (Du Prez *et al* 2014), thiol-isocyanate chemistry, combined with a dual capsule strategy, has been used for the development of extrinsic self-healing epoxy materials. It is shown that the amine groups present in the matrix both serve as a catalyst for the addition reaction between a thiol and an isocyanate and as a way to covalently link the healed network structure to the surrounding resin. The tapered double cantilever beam (TDCB) geometry is used for evaluating the recovery of the fracture toughness at room temperature after different healing times. Using manual injection of the healing agents into the crack, a healing efficiency up to 130 % is obtained. On the other hand, when two types of microcapsules, one containing a tetrathiol reagent and the other a low toxic isocyanate reagent, are incorporated into this epoxy thermoset (20 wt%), a recovery of more than 50 % is reached. MicroCT has been used to explain the lower self-healing efficiency. The influence of parameters such as the amount and core content of the microcapsules on the healing efficiency is investigated. Furthermore, the thiol-isocyanate chemistry has also been tested for an industrial cold-curing epoxy resin.

REFERENCES

Hillewaere, X. et al. (2014), *"Autonomous self-healing of epoxy thermosets with thiol-isocyanate chemistry"*, Advanced Functional Materials **24**, 5575–5583.