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ABSTRACT:

Deformation, Damage and Fracture of Semi-Crystalline Polymers. Dialogue Between Advanced Experimentation in 4D and Numerical Modelling

This contribution addresses the relationship between microstructural evolution and constitutive modelling of semi-crystalline polymers.

These materials exhibit spherulitic microstructures, which enable the measurement of local three-dimensional deformation through comprehensive tomographic data sets. The mechanisms of deformation, damage, and failure were analyzed as a function of the applied loading conditions (increasing load or creep). These insights informed the selection of the most suitable constitutive model within the frameworks of continuum mechanics, damage mechanics and fracture mechanics, using the Finite Element Method (FEM).

The transferability of results obtained from laboratory specimens to engineering structures was then assessed, enabling the prediction of failure in terms of mechanical strength (increasing load) and/or long-term durability (creep lifetime assessment).