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ABSTRACT:

Experimental Setup for in Situ Investigation of Structure Formation During Solidification of Polymer Melts under Process-Near Conditions via Synchrotron SWAXS

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Advanced experimental testing is essential for reliable material modeling and simulation. In the case of semi-crystalline thermoplastics, the microstructure is significantly influenced by the processing procedure. For commercially used processing methods, such as injection molding and extrusion, locally different inhomogeneous flow fields affect the melt. Investigations of the influence of complex flow fields on the structure formation of semi-crystalline thermoplastics are therefore of high interest. Although the influence of crystallization kinetics on the properties of the most commonly used polymers is considered well-known, there are still many unknown (local) conditions and parameters that affect the crystallization behavior, such as local shear stress or pressure and temperature profiles. To investigate these types of interactions, a new experimental setup called "FlowCell" was realized, which allows the in situ investigation of the structure formation of polymer melts using synchrotron X-ray scattering. By improving the FlowCell functionalities and its integrated sensors, an understanding of process-dependent crystallization kinetics could be enhanced, paving the way for a digital twin representing the structure of thermoplastic components.