In-situ x-ray characterization of polymer crystallization under processing relevant conditions

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Stan F.S.P. Looijmans, Ruth M. Cardinaels and Lambèrt C.A. van Breemen

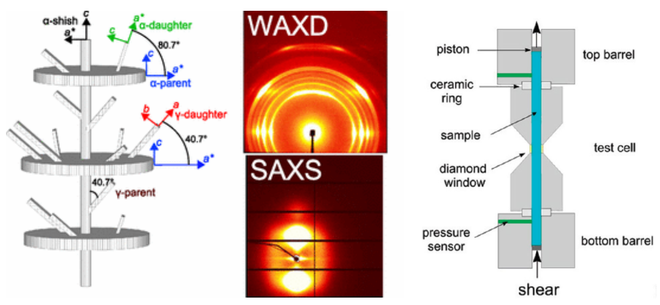
Polymer Technology, Department of Mechanical Engineering, Eindhoven University of Technology,
P.O. Box 513, 5600 MB Eindhoven, The Netherlands

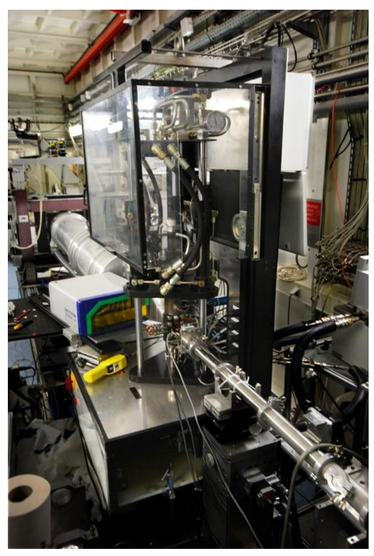
Objective

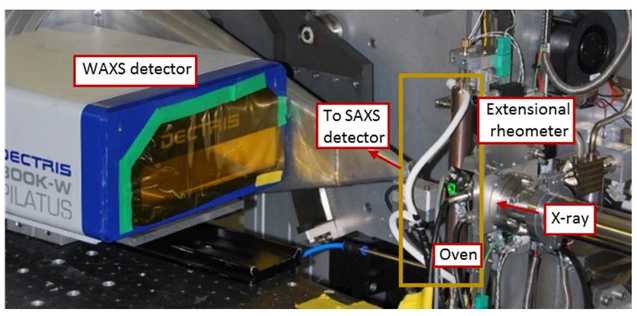
Over the last two decades, we have extensively used the SAXS/WAXS Dutch-Belgian beamline DUBBLE at the ESRF, where we used our engineering background to develop advanced devices that allow us to study the crystallization of polymers under real processing conditions combined with in-situ x-ray analysis. Our expertise in this field has led to many successful, high-demanding experiments at the DUBBLE beamline. We developed among other things, a high-pressure rheometer to study the shear induced crystallization in the injection moulding process, an extensional rheometer with a stationary centre-point to follow in-situ the structure formation when a polymer melt is stretched, and a selective laser sintering setup where we can sinter two micron sized particles while recording a combined SAXS/WAXS signal during sintering.

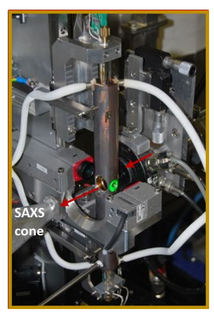
Rheometry

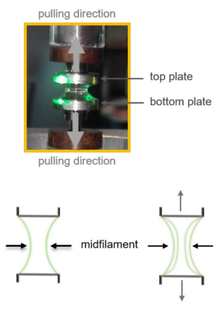
Understanding the crystallization of iPP in conditions comparable to processing. The polymer melt experiences both high shear rates and elevated pressures [1].



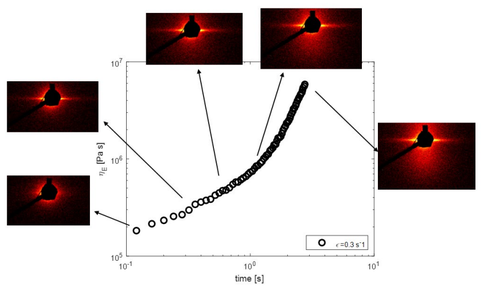




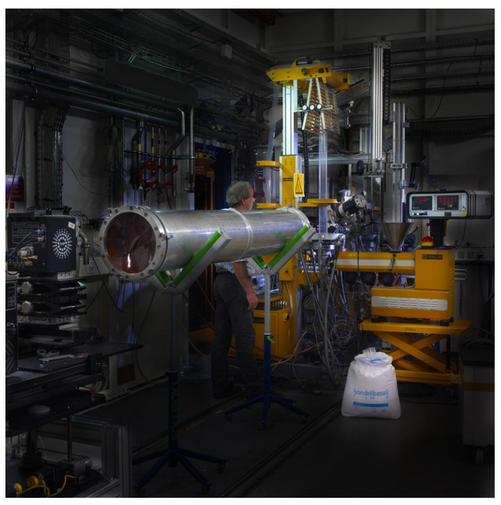


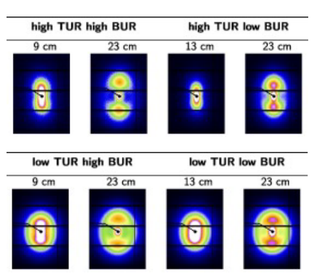


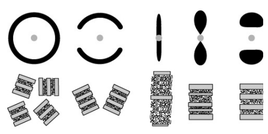
In-situ study of the crystallization of a polymer melt when subjected to an extensional flow, leading to the formation of a shish-kebab morphology.



Film blowing



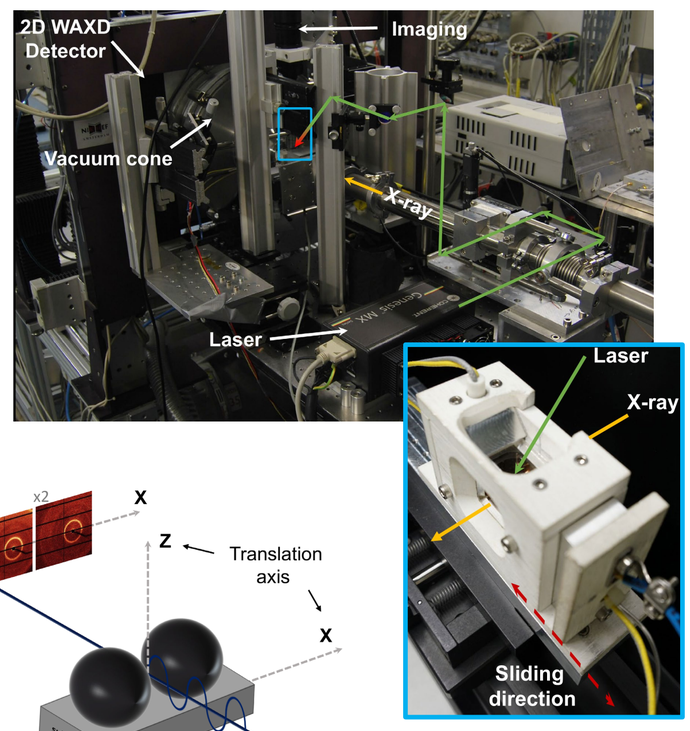


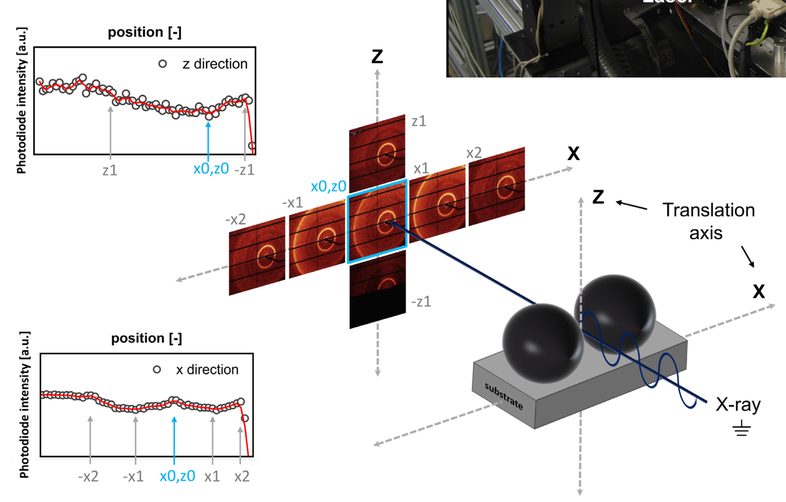


The effect of blow-up ratio and take-up ratio on the morphology development during film blowing [2].

Selective laser sintering

Sintering of two micron sized PA-12 particles to capture the melting and crystallization kinetics, relevant for SLS [3].





Future work

Application of a pressure quench to study meso-phase development in iPP.

Deformation kinetics of transcrystalline iPP, governing failure of fiber reinforced polymer composites.

/ department of mechanical engineering

[1] E.M. Troisi et al. *Macromolecules*. **2017**, *50*, 3868-3882.
[2] E.M. Troisi et al. *Eur. Polym. J.* **2016**, *74*, 190-208.
[3] P. Hejmady et al. *Rev. Sci. Instr.* **2019**, *90*, 083905.