ESRF	**Experiment title:** SAXS Study of the Formation Process of Highly Oriented Lamellae During the Crystallization of Polyethylene	**Experiment number:** SC-1396
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Report:

Abstract. Isothermal (various temperatures) and non–isothermal quiescent oriented crystallization of polyethylene (PE) was recorded with high time resolution (7 s) and excellent S/N-ratio on 2D USAXS and 2D WAXS detectors. CDF-images in real space exhibit the mechanisms of PE crystallization (and melting). First results demonstrate the validity of Strobl's block crystallization model[1] and refine it in several respects. The CDF images as a function of time and temperature are now available on the web http://www.chemie.uni-hamburg.de/tmc/stribeck/crys/ manuscripts are in preparation. Special commendation to Peter Bösecke for his programming of the temperature control program and the exposure time control. As a result we were able to run complex temperature programs and to adjust the exposure time while the experiment was running.

Results

- Blocks are the primary fundamental domain shape during crystallization of polyethylene (polymers?) (cf. Figure 1)
- Such floes can freeze together and form extended lamellae
- If such extended lamellae are melted, they will not be broken up into blocks again
- The primary block regime is characterized by lateral correlation of the blocks (like floes on the water surface)
- Always these primary blocks freeze together and form lamellae which occupy part of the materials volume. Their distribution is random (random car parking)[2, 3]
- As the parking ground is being filled up, frustration is growing. Now secondary floes are filled in, which undergo correlations both with each other and with the perfect lamellae in lateral and in longitudinal direction. This is the distorted lattice (”stack”, ”paracrystal”)
- Longitudinal correlation among domains upon insertion of floes comes first, second comes lateral correlation among floes belonging to the same layer.
- Finally, this network of frustrated floes is going to dominate the nanostructure.
- Even when a floe network is kept at high temperature for a long time, not many floes do merge and form lamellae. Instead, they improve similarity and correlations among each other on the short range.

References

[1] Hugel T, Strobl G, Thomann R (1999) Acta Polym 50:214
[2] Stribeck N (2004) Macromol Chem Phys submitted
[3] Stribeck N, Almendarez Camarillo A, Bayer R (2004) Macromol Chem Phys submitted