# Combined neutron and rheological studies of polymer networks, revealing shear-controlled texturing and shear-induced instabilities (invited paper)

**Mortensen, K.**

*Publication date:*
2005

*Document Version*
Publisher's PDF, also known as Version of record

*Citation (APA):*
Mortensen, K. (2005). *Combined neutron and rheological studies of polymer networks, revealing shear-controlled texturing and shear-induced instabilities (invited paper)*. Abstract from International symposium on polymer co-networks, gels and membranes, Budapest (HU), 11-13 Sep, .

---

# Combined neutron and rheological studies of polymer networks, revealing shear-controlled texturing and shear-induced instabilities

Kell Mortensen
Danish Polymer Centre Risø National Laboratory Roskilde Denmark
kell.mortensen@risoe.dk

Combined studies of small-angle scattering and oscillatory-shear instrumentation are effective tools for studying structure and real-time dynamics of soft matter materials.

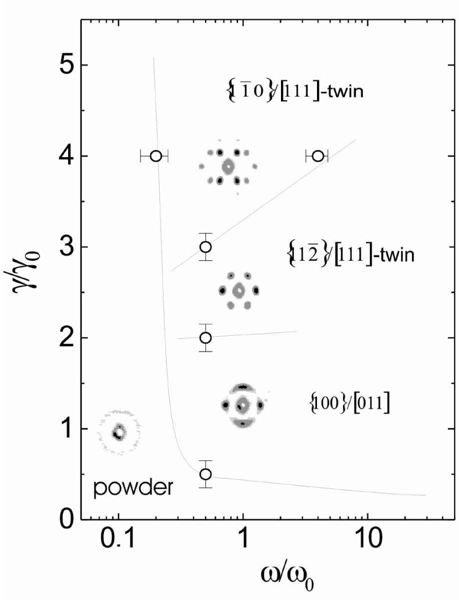

**Fig. 1** Shear diagram of the bcc phase of a SEBS block copolymer micellar network, showing the different crystal orientations that emerge as a result of mechanical treatment [1,2].

Applying well-controlled large-amplitude oscillatory shear can be used to effectively control the texture of soft matter materials in the ordered states[1]. An example is the unique control one may have on the lamellae orientations in LAM-ordered, symmetric diblock copolymers. A related example is the body-centered-cubic phase of diblock copolymer melts as well as block copolymer micellar gels, showing remarkably related shear dependent texture: Detailed crystallographic studies show that both intermediate-amplitude oscillatory shear and large-amplitude oscillatory shear lead to twin structures with {112} planes sharing neighboring twins and (111) axes parallel to the shear flow [2]. At high shear amplitude, the shear plane is parallel to the {110} crystallographic planes, while at moderate shear-amplitude the shear-plane is rotated 90°, *viz* parallel to the {112} twin-planes. The low-amplitude shear-texture is dominated by {001} planes perpendicular to the shear gradient and by the (110) axis parallel to the flow-direction. Shear, however, may not only influence the texture. Shear may also affect the thermodynamic ground state, causing shear-induced ordering and disordering (melting), and shear-induced order-to-order transitions. Examples are the shear-induced bcc-to-fcc transition in block copolymer micellar networks, shear-induced ordering in diblock copolymer melts and shear-induced destabilization of the complex gyroid state [3].

## References:

[1] K Mortensen, E Theunissen, R Kleppinger, K Almdal, H Reynaers. *Macromolecules* **35**, 7773 (2002)
[2] K Mortensen *J. Polymer Science B: Polymer Physics*, **42**, 3095 (2004)
[3] R Eskimergen, K Mortensen, M E. Vigild *Macromolecules 38, 1286* (2005)