ESRF	**Experiment title:** **Tuning of Block Copolymer Spacings using Electric Fields**.	**Experiment number**: SC-2387
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Report:

This report deals with the beam time of the project SC-2387. Here, we observed in detail the influence of the electric field on the charcteristic microdomain spacings of lamellar polystyrene-*b*-polyisoprene (PS-*b*-PI) block copolymer systems with different compositions ($S_{46}I_{54}^{108}$, $S_{50}I_{50}^{100}$, $S_{55}I_{45}^{51}$, $S_{58}I_{42}^{48}$, $S_{64}I_{36}^{47}$). In addition we investigated the behavior on a cylindrical block copolymer system ($S_{75}I_{25}^{66}$). For these experiments we used a temperature controlled (RT – 90°C) sample cell that consists of a capacitor with variable spacing (d = 0.1 – 4mm). We applied elecrtic fields up to 13 kV/mm.

We found a significant influence of the block copolymer composition on the magnitude of the chain streching effect. This is illustrated in Figure 1, where five different block copolymers with varying PS content (all 50wt.% solution in THF) are compared by calculating the slope of the Δd versus electric field strength E curves. As the composition determines the entropic energy, an asymmetric copolymer is expected to exhibit a lower entropic energy than an asymmetric one. Hence, the increase of the entropic energy by electric field induced chain streching is more efficient for a symmetric copolymer, leading to a more pronounced effect for the symmetric block copolymer in this study.

If a cylinder forming system is considered, the same chain streching effect as found for lamellae is observed. For cylinders lying in the field direction the distance between the cylinders is strongly decreasing whereas the distance for cylinders aligned perpendicular is slightly increasing on application of an electric field. This behavior is illustrated in Figure 2. In this case the cylinder forming component is PI embedded in a matrix of PS. PI will be streched parallel to the field lines, i.e. the cylinders parallel to the field lines become thinner while the matrix does not change because of the low polarizability of the PS chains. Since the PI chains are covalently attached to the PS chains not only the cylinder diameter is decreasing but also the distance between the cylinders. The results found during this beam time will be published soon.

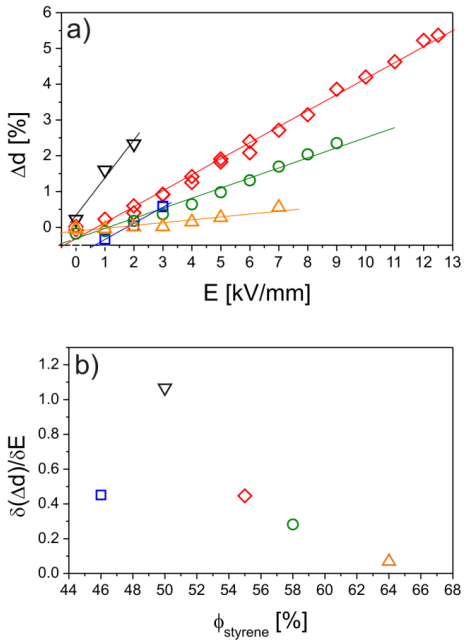

*Figure 1: (**a**) Dependence of the relative change in the lamellar distance Δd on the electric field strength E for different block copolymer compositions: $S_{46}I_{54}^{108}$ (blue), $S_{50}I_{50}^{100}$ (black), $S_{55}I_{45}^{51}$ (red), $S_{58}I_{42}^{48}$ (green) and $S_{64}I_{36}^{47}$ (orange), all 50 wt.% solutions in THF. (**b**) Dependence of the strength of the chain streching effect on the styrene volume fraction for the same solutions.*

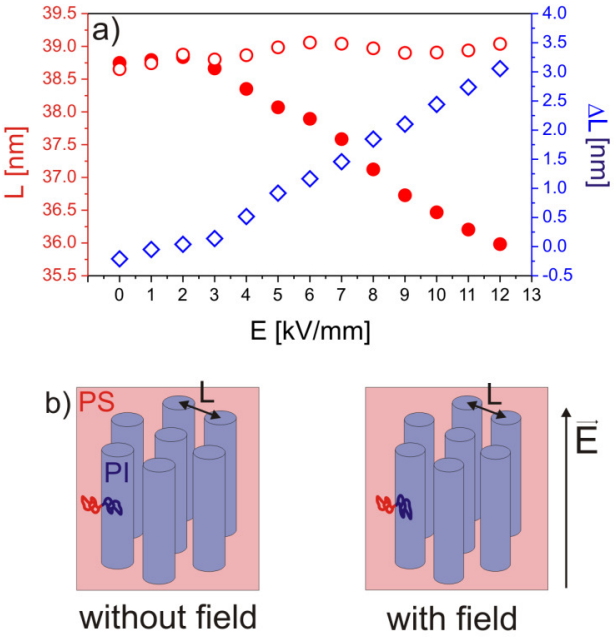

*Figure 2: (**a**) Dependence of the cylinder distance L of aligned (filled circle) and non-aligned (open circle) cylinders and of the difference (blue) ΔL on the electric field strength for a 45 wt.% solution of $S_{75}I_{25}^{66}$ dissolved in toluene. (**b**) Sketch of the chain stretching effect for aligned cylinders.*