

Experimental report for experiment SC-2667 30 April 2009 / 03 May 2009

"Time-Dependence Microdomains Alignment and Order-to-Order Transitions in Self-Organized Block Copolymer Solutions under External Electric Field".

We evidence the possibility of electric field induced phase transitions in soft matter systems. A cubic to hexagonal rearrangement was achieved from a 3D cubic organization self-developed by dissolving PS-*b*-PEP (polystyrene-*block* poly(ethylene-*co*-propylene) in a mixture of cyclohexane (CH) and DMF. The order-to-order evolution was proved to be reachable by the application of a DC electric field ~ 1.25 kV/mm. The electric field generates dipole moments in DMF-rich spherical microdomains and they then could be deformed in further interconnected leading to the formation of the hexagonal packed cylinders configuration. The electric field strength needed to induce such conversion was found to be dependent on the magnitude of the generated dipole moment in the DMF-rich spherical microdomains and hence dependent on their size and dielectric contrast irrespective to the surroundings. The surroundings must have the lower dielectric constant in order to the modifications to be physically possible. The electric field strength is also dependent on the block copolymer concentration covering the liquid-liquid interfaces and it has been found that the HEX-cylinders phase developed under external electric field is unstable and as soon as it is switched-off, the cylinders undergo again an order-to-order transition back to the cubic phase. Finally, a thermodynamically stable HEX-cylinders phase was also designed by dissolving PS-*b*-PI (polystyrene-*block*-polyisoprene) in a CH-DMF mixture at $E = 0$ kV/mm. In such a case, the structure essentially does not feel the presence of an electric field of the same magnitude.

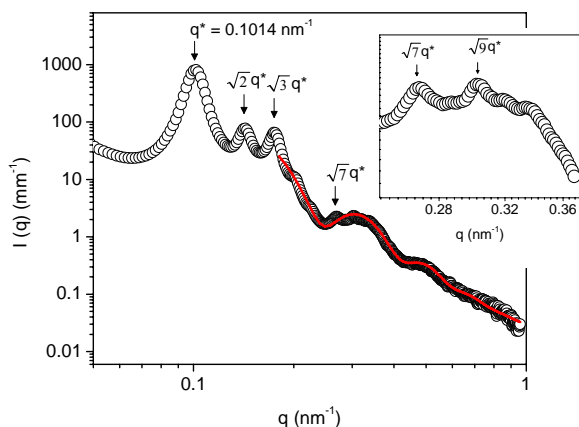


Figure 1. $I(q)$ vs. q SAXS profile for 10% w/w PS-*b*-PEP dissolved in the partially miscible solvents CH-08%DMF at $E = 0$ kV/mm.

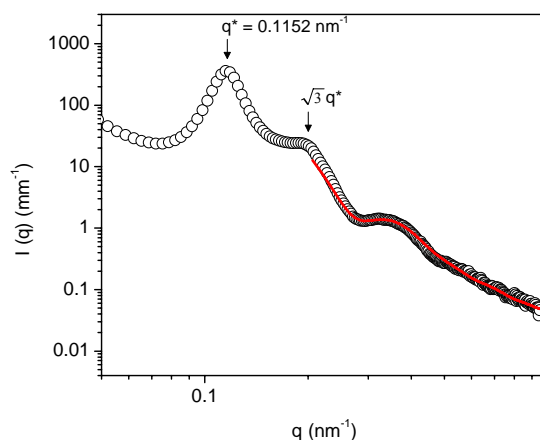


Figure 2. $I(q)$ vs. q SAXS profile for 10% w/w PS-*b*-PEP dissolved in the partially miscible solvents CH-08%DMF and under external electric field ($E = 1.25$ kV/mm).

Publication:

F. C. Giacomelli, N. P. da Silveira, M. Steinhart, P. Štěpánek, "Cubic to Hexagonal Phase Transition Induced by Electric Field", *Macromolecules*, submitted 2009