Diblock copolymers in nonuniform electric fields

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The influence of spatially uniform electric fields on block copolymers has been the subject of intensive research. In this work we go one step further and look at the forces nonuniform electric fields exert on copolymers. The competition between elastic and electrostatic forces may lead to order-order phase transitions, interfacial instabilities, or even to melting of the BCP phase. Specifically, we look at symmetric diblock copolymers confined in a coaxial capacitor. We minimize numerically the system free energy comprised of a polymeric part, electrostatic and interfacial energy parts. We find that at low values of voltage (field) lamellae form coaxially around the inner cylinder. As the voltage (field) is increased the preferred morphology is that of lamellae oriented radially parallel to the field. This effect is more pronounced as the segregation becomes weaker (closer to the critical point). At intermediate values of the field we find interfacial instabilities where lamellae are deformed at a wavelength comparable to their thickness.

References

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