Polymers in Nanopores

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The material science under nanoscopic confinement has been focused mainly on planar films but are now being shifted to other geometry such as cylindrical nanopores. During the recent years, we found some examples where frustration, induced by curvature, breaks the symmetric structure of self-assembled block copolymers. The structure of crystalline materials were also found to be controlled by the imposed curvature in a nanoscopic cylindrical pore. In addition, crystallization behavior in the cylindrical nanopore is drastically altered upon the degree of confinement. Not only crystalline or hyperstructured materials but also polymeric melt show breakdown of bulk behaviors under this nanoscopic confinement. When the dimensions of a confining volume are much less than the radius of gyration of a glassy polymer, weak molecular-weight dependent mobility of polymers confined within nanoscopic cylindrical pores is observed. On the basis of the chain configuration along the pore axis, the measured mobility of polymers in the confined geometry is much higher than the mobility of the unconfined chain. With the emergence of nanoscale science and engineering, those unexpected physical behaviors are of significant importance in the design and execution of nanofabrication strategies.