Nanostructured Polymer Surfaces by Spin coating: A Combined Study by Atomic Force Microscopy(AFM) and Grazing Incidence Small Angle X-ray Scattering (GISAXS)

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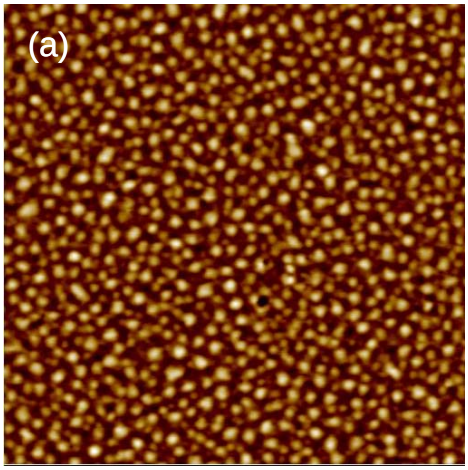
Pattern formation in fluid films with thicknesses in the nanometer range (< 100 nm) plays a central roll for a huge battery of potential technological applications [1-3]. In particular, the increasing interest in polymer thin films mainly comes from the possibility of creating functional surfaces [1,3]. The controlled structuring of polymer films, at the nanometer scale, is a necessary requisite for many of these potential applications. Nanostructuring in polymeric thin films can be obtained by using homopolymers, block copolymers and --+-+blends [3]. For homopolymers nanostructured surfaces can be produced taking advantage of spontaneous dewetting appearing when the polymer film becomes unstable [2,4]. In this work we present a combined study of nanofilms of Poly(butylene terephthalate) (PBT) by means of Atomic Force Microscopy (AFM) and Grazing Incidence X-ray Small Angle Scattering (GISAXS) with synchrotron light (HASYLAB, DESY, BW4 beam line). Homogeneous PBT films have been prepared by spin-coating from solutions of PBT in trifluoracetic acid. The thickness of the films, as estimated from optical ellipsometry, can be controlled between 10 nm and 100 nm depending on the solution concentration. Fig.1a shows that thin films of PBT (≈13 nm) exhibit a spontaneous pattern formation characterized by columns, 8 nm in height and 140 nm wide, separated by an average distance of 180±20 nm. The corresponding GISAXS pattern (Fig.1b) presents an out of plane scattering consistent with the columnar phase observed by AFM. Indeed, a characteristic length scale of 209 nm, assigned to the mean distance among columns, is derived for the lateral structure correlation observed. The observed nanostructuration can be tentatively explained in terms of dewetting phenomena.



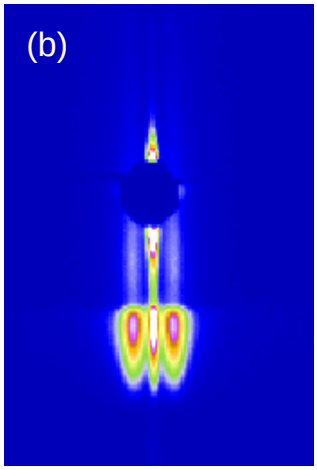


Figure 1 (a)AFM tapping mode height image (5x5 μm^2) and (b) GISAXS pattern of a PBT film 13 nm thick.

References

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