A characterization of Poly(L-lactic acid) thin films via AFM, ellipsometry and X-ray scattering

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In this work we present the combined dynamic and structure characterization of the semicrystalline polymer poly(L-lactic acid) (PLLA) confined in thin film geometry. We have determined the melting temperature (T_m) of the films, while being annealed at a constant rate, by means of spectroscopic ellipsometry measurements. Films thinner than the lamellar thickness of the bulk polymer showed constant T_m. This fact was further studied via the thickness dependence of the crystalline morphology by Atomic Force Microscopy, and the chain organization in the direction perpendicular to the supporting substrate and long-spacing of the polymer, by X-ray scattering. Both SAXS and WAXS experiments were conducted to investigate the lamella structure.

We observed that when the polymer is confined below its lamellar thickness, PLLA develops structures of a constant height (around 13 nm), regardless of the initial thickness of the amorphous film. The melting temperature plateau observed in ultrathin films could be related to the development of these crystalline structures equal to one lamellar thickness.