Near-surface crystallization in polyesters

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Abstract

The near-surface properties of thermoplastic polymers are of interest, particularly where thin film coatings or other structures are to be subsequently applied. Previous work by AFM and ellipsometry has established that the glass-transition temperature in the near-surface region is depressed by up to tens of Kelvin, leaving the surface vulnerable to deformation and penetration during coating processes such as metallization. We have also shown that the near-surface region of PET shows enhanced crystallinity. This paper will report our AFM studies of PET, PEN and copolymers thereof and the near-surface crystallization that can be induced by annealing at temperatures at which the surface molecular segments are mobile, but those in the bulk underneath are not. We demonstrate the characteristic morphologies associated with the surface crystallization and changes in the crystal orientation as growth proceeds. Comparison is made with other polymer systems we have studied including near-surface phase separation and unique crystal morphologies at the surface in polyurethanes.

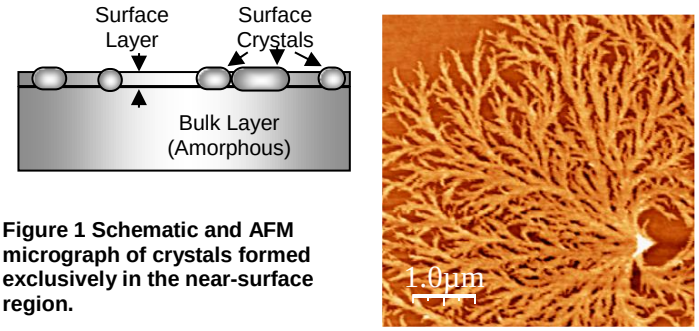


Figure 1 Schematic and AFM micrograph of crystals formed exclusively in the near-surface region.

Recent Publications

1. Pratt FL, Lancaster T, Brooks M, Blundell SJ, Prokscha T, Morenzoni E., Suter A, Luetkens H, Khasanov R, Shinotsuka K, Assender HE (2005) Surface dynamics of a thin polystyrene film probed by low energy muons. Physical Review B 72:121401
2. Shinotsuka K, Bliznyuk VN, Assender HE (2012) Near-surface crystallization of PET. Polymer 53:5554-5559
3. Jiang L, Wu J, Nedolisa C, Saiani A, Assender HE (2015) Phase separation and crystallization in high hard block content polyurethane thin films. Macromolecules 48:5358-5366
4. Shinotsuka K, Assender, HE (2016) In-Situ AFM study of near-surface crystallization in PET and PEN. J. Applied Polymer Science 133:44269
5. Shinotsuka K, Assender HE, Claridge TDW (2018) Synthesis of statistical PET/PEN random block copolymers and their crystallizability in the bulk and at the surface. J. Applied Polymer Science Early view APP46515.



Biography

Prof Hazel Assender has led a research activity at the Department of Materials, University of Oxford, since 1996, with a focus in the area of thin films and coatings both of polymer materials or onto polymer substrates. She graduated from the University of Cambridge, following this with a PhD, and two years of postdoc in the Department of Materials Science & Metallurgy in Cambridge before moving to an academic post in Oxford. Her research spans fundamental studies of the thin film and near-surface properties of polymers, through to materials engineering of thin films and device structures in large area on polymer substrates. Particular areas of interest include roll-to-roll deposition, gas barriers, photovoltaics, and transistors/circuits. Her research has a technology-facing approach bringing underpinning scientific understanding to development of materials and technologies that integrates research relevant to industrial processing such as scale-up of manufacture with the development of new materials and structures.

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