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Oriented recrystallization of carbon-coated pre-oriented ultrathin polymer films

The multiscale morphologies of the polymeric materials in the condensed state exhibit pronounced influences on the mechanical and physical properties of the polymers. For crystalline polymers, the crystalline structure and crystal orientation provide another most important key factor in regulating the property and/or even functionality of a polymer. Therefore, the study on the crystallization of semi crystalline polymers under various conditions is an everlasting research topic. Here, the recrystallization behavior of carbon-coated preoriented polymer thin films was studied by means of transmission electron microscopy combined with electron diffraction and spectroscopy. It was found that vacuum evaporated carbon layer can keep the molecular chain orientation of pre-oriented polymer thin films. This demonstrates the existence of strong fixing effect of vacuum evaporated carbon layers on the surface layer of the polymer films, which prevents the relaxation of surface extended macromolecular stems in the crystals or at least from a complete relaxing during high-temperature melting. The fixed surface molecular chains have in turn induced the oriented recrystallization of the thin polymer molten layer. It was further found that the crystal structures and morphologies can be well controlled through regulating the crystallization temperature. For example, the α to β transition of poly (vinylidene fluoride) has been achieved by melt recrystallization of carbon-coated highly oriented PVDF ultrathin films at atmospheric pressure. Moreover, through selective carbon-coating with the help of a mask and subsequent recrystallization of the pre-oriented polymer thin film lead to patterned structure control in the coated domains of a polymer thin film. A fully structure control can be fulfilled through a combination of surface carbon-coating at desired domains and recrystallization on an oriented substrate with heteroepitaxy.

Biography

Shouke Yan is Professor in the College of Material Sciences and Engineering at Beijing University of Chemical Technology (BUCT) in Beijing. He has completed his MS in Polymer Science at the Changchun Institute of Applied Chemistry, the Chinese Academy of Sciences (CIAC-CAS). He has earned his PhD in Polymer Science at the CIAC-CAS under the joint guidance of Prof. Decai Yang and Prof. J Petermann (Dortmund University, Germany) through a sandwich program between the CAS and the Max-Planck-Society. He then took a position on the research staff at Dortmund University. In 2002, he has returned to China through the Hundred Talents Program to become full Professor at the Institute of Chemistry, the Chinese Academy of Sciences (ICCAS). He has been recognized with several honors, including the Excellent Hundred Talents Award and an NSFC Outstanding Youth Fund. His current research involves surface-induced polymer crystallization, orientation-induced polymer crystallization and phase transition of crystalline polymers.

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