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Structure of Oriented PLA/Graphene Nanocomposite Fibers[1]
QIAN MA, Tufts University, MAREK PYDA, Poznan University of Medical Sciences, BIN MAO, Tufts University, ERIKA SIMONA COZZA, ORIETTA MONTICELLI, Università di Genova, PEGGY CEBE, Tufts University — Highly-aligned polylactic acid (PLA)/graphene nanocomposite fibers were successfully electrospun. Through a combination of thermal analysis and X-ray scattering, the phase structure, molecular orientation, and fiber shrinkage of the oriented PLA fibers were investigated to evaluate the molecular chain confinement. Calorimetric studies were performed to identify the molecular origin of the post-T_g exothermic peak. We found that the shrinkage of the oriented amorphous polymer serves as a precursor for the cold crystallization revealed by the post-T_g exotherm. Using real-time 2-D wide angle X-ray scattering and molecular retraction tests, we further quantified the orientation level and the oriented amorphous fraction in the as-spun amorphous fibers, and investigated the subsequent formation of oriented crystals during heating under "frozen-in" tension. The preferentially oriented amorphous region that possesses a degree of medium-range order has high similarity with the concept of the rigid amorphous phase that has been widely studied in thermal analysis area, and a new phase structure model was established. Graphene filler has a significant influence on molecular orientation, crystallization behavior, and electrical conductivity of PLA fibers.

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