607e Evolution of Crystalline Morphology in Poly(Trimethylene Terephthalate) and Ptt-Based Blends

Sumod Kalakkunnath, Terry W. Humphries, and Douglass S. Kalika

Poly(trimethylene terephthalate) [PTT] is a semicrystalline polyester based on the condensation polymerization of terephthalic acid (TA) and 1,3-propanediol (PDO). Recent advances in the manufacture of PDO has led to commercial production of PTT with considerable interest in the fiber and film markets. PTT is a member of the series of aromatic polyesters that includes both PET and PBT, and the presence of three methylene moieties in the repeating unit introduces a "kink" along the chain backbone, in contrast to the conformations observed for PET and PBT. PTT can be quenched to relatively low degrees of crystallinity (~15%), or processed to overall levels of crystallinity on the order of 40 to 50%. The position and intensity of the dynamic relaxation processes in crystallized PTT are sensitive to the thermal history of the material and the corresponding details of the crystalline morphology.

In this work, the crystallization, melting and dynamic relaxation characteristics of PTT and PTT blends have been studied as a function of thermal processing history. Of particular interest is the position and intensity of the sub-glass (β) and glass-rubber (α) relaxations as investigated by broadband dielectric relaxation spectroscopy and dynamic mechanical thermal analysis. Crystallized PTT displays a significant rigid amorphous phase fraction, and the variation of rigid amorphous fraction with thermal history can provide valuable insight as to chain conformation and local order across the crystal-amorphous interphase. Both calorimetric and dielectric methods were used to characterize the relative phase fractions according to the three-phase model, and the results are contrasted with the behavior of other semicrystalline engineering thermoplastics such as PET, PPS, and PEEK.

In addition, blends of PTT with high-temperature amorphous thermoplastics (e.g. polyetherimide, PEI) have been explored. For these blend systems, the influence of the non-crystallizable (polymeric) diluent has been assessed in terms of crystallization kinetics, bulk crystallinity, and potential amorphous phase segregation.