Microstructure Control During Melt-spinning of Continuous Pitch-based Carbon Fibers

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Abstract

Carbon fibers possess excellent specific strength and have been extensively used in high-end composites. Polyacrylonitrile (PAN)-based carbon fibers dominate the market, but their high cost limits their use to aircraft/aerospace applications. Utilizing a low-cost mesophase petroleum pitch as a raw material is considered as an alternative, but the relatively low tensile strength is one major drawback of pitch-based carbon fiber. One of the possible solutions is to control microstructure during pitch precursor fiber formation. In this work, a single-screw extruder was used to produce low-cost pitch precursor fibers using a continuous spinning process. The as-spun fibers were stabilized at about 200°C and carbonized at 2100°C to produce continuous carbon fibers. The fibers were characterized by scanning electron microscopy (SEM) and shown to possess a fine-textured circular layer plane microstructure. Fine diameter carbon fibers were successfully produced that possessed a tensile strength and modulus of 2.5 GPa and 350 GPa, respectively. This combination is amongst the best reported in the literature for petroleum pitch-based carbon fibers.