Effect of Coagulation Bath Temperature And Polymer Composition On The Fabrication and Characteristics of PAN Precursor Fiber in the Solvent-Free Coagulation Process

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Abstract

The objective of this research is to investigate the appropriate range of coagulation bath temperature and polymer solution composition for spinning process in the solvent-free coagulation process and the effect of these parameters on carbon fibers precursor. The fabrication of the precursor fibers in the solvent-free coagulation process was carried out at a low residence time. The precursor fibers with excellent axial orientation and less number of micro-pores possess superior mechanical properties and enhance the performance of resulting carbon fibers. In the first stage of this study, the PAN polymer solution was prepared with incorporation of acrylamide as an additive. The PAN/AM fibers were produced using a simple dry-wet spinning process. The PAN/AM fibers were then subjected to the oxidation process at 250 °C in an oxygen-containing-atmosphere before underwent the carbonization process at 1000 °C. Through these studies, that a semi-dilute solution (18 wt.%) was found to be the most suitable polymer composition for the PAN/AM fibers fabrication at room temperature. It eased the fabrication process and produced the PAN/AM fibers with better mechanical properties. The PAN/AM fibers produced at coagulation bath temperature of 13 °C exhibited the excellent mechanical properties. At the coagulation bath temperature of 13 °C, the inward diffusion of non-solvent was still slow and consequently reduced the number of micro-pores and fit for the drawing process. The ratio of carbon fiber to precursor modulus (E_c/E_p) was calculated to be about 16.5, which was relatively acceptable value as published elsewhere. It can be concluded that the PAN precursor fibers were successfully produce in the solvent-free coagulation process which possessed competitive mechanical properties.

Keywords:
PAN/AM fibers, Solvent-free coagulation bath, Carbon fibers, Mechanical properties, Fiber spinning

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