

PAN 纤维预氧化过程中牵伸对纤维结构与性能的影响

摘要

在聚丙烯腈（PAN）基碳纤维的制备过程中，预氧化是影响纤维结构和性能的关键工艺。热收缩现象在预氧化过程中出现，并且对纤维的化学结构、微观结构以及力学性能有一定影响。为了明确热收缩对纤维结构的影响，避免收缩行为降低最终碳纤维性能，本文通过傅里叶红外光谱（FTIR）、扫描电子显微镜（SEM）和拉伸测试等技术，研究了预氧化过程中有无牵伸状态下（自由收缩和固定长度）PAN 纤维的化学结构、微观结构以及力学性能。结果表明，预氧化过程中，牵伸抑制环状结构的形成，促进氧化反应的发生。在较高预氧化温度下，PAN 纤维有皮芯结构产生，在牵伸作用下的纤维结构更加致密，直径更小。有牵伸的纤维比无牵伸的纤维断裂伸长率略小，拉伸强度略大，力学性能更加优异。

关键词：聚丙烯腈；化学反应；皮芯结构；力学性能

Abstract

In the preparation of polyacrylonitrile (PAN) based carbon fibers, thermal oxidative stabilization (TOS) is the key process affecting structure and properties of the fibers. Thermal shrinkage phenomenon occurs in the TOS process, and has a certain effect on the chemical structure, microstructure and mechanical properties of fibers. In order to identify the effect of thermal shrinkage on the structure of fibers and avoid the behavior decreasing the properties of final carbon fibers, the chemical structure, microstructure and mechanical properties of PAN fiber with or without drawing (free shrinkage and fixed length) during TOS process were studied by Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM) and tensile test. The results show that in the TOS process, stretching inhibits the formation of cyclic structure, but promotes the oxidation reaction. At higher thermal treatment temperature, PAN fibers have skin-core structure. Under the action of stretching, the fiber structure was more compact, and smaller in diameter. The elongation at break of drawing fibers is slightly lower than no drawing fibers, the tensile strength is slightly higher, and the mechanical properties are better.

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