On the morphology and structure formation of carbon fibers from polymer precursor systems

Muhannad Al Aiti, Dieter Jehnichen, Dieter Fischer, Harald Brünig, Gert Heinrich

PII: S0079-6425(18)30072-0
DOI: https://doi.org/10.1016/j.pmatsci.2018.07.004
Reference: JPMS 526

To appear in: *Progress in Materials Science*

Received Date: 30 October 2017
Revised Date: 29 June 2018
Accepted Date: 5 July 2018

Please cite this article as: Al Aiti, M., Jehnichen, D., Fischer, D., Brünig, H., Heinrich, G., On the morphology and structure formation of carbon fibers from polymer precursor systems, *Progress in Materials Science* (2018), doi: https://doi.org/10.1016/j.pmatsci.2018.07.004

On the morphology and structure formation of carbon fibers from polymer precursor systems

Muhannad Al Aiti[1,2,*], Dieter Jehnichen[1], Dieter Fischer[1], Harald Brünig[1], Gert Heinrich[1,3]

[1] Leibniz-Institut für Polymerforschung Dresden e.V., D-01069 Dresden

[2] Technische Universität Dresden, Institut für Leichtbau und Kunststofftechnik, D-01062 Dresden

[3] Technische Universität Dresden, Institut für Textilmaschinen und Textile Hochleistungswerkstofftechnik, D-01062 Dresden

*****corresponding author; E-Mail: aiti@ipfdd.de

This review paper summarizes and critically discusses the morphology and structure formation of carbon fibers (CFs) from polymer precursor systems. Throughout this review, we focus on the key mutual interactions between the polymeric precursor systems, their physically determined processability into filaments, the thermally initiated crystal conversion mechanisms, as well as the morphological and physical properties of the resulting CFs and graphite fibers (GFs). Understanding the behavior of crystal conversion mechanisms from a polymeric semi-crystalline structure into a turbostratic, glass-like or even a graphite-like carbonaceous crystalline structure is essential to carbon and graphite fiber formation. The nature of the crystal conversion and thermal processing largely determine the recovery degree and behavior of the carbonaceous crystal orientation. Over the last three decades, CFs and GFs have earned a significant reputation as lightweight fibrous reinforcement materials, and considerable advances have been achieved in understanding the structure of CFs and GFs and in tailoring their performance towards specific applications. The utilization of CFs and GFs in different thermoplastics and thermosets, as well as in concrete as reinforcements, is well known thanks to the abundant number of reports and reviews available. Nevertheless, large-scale utilization of CFs in high-technology sectors, such as the aerospace industry, is mainly driven by the required performance of the CFs. For civilian applications such as general engineering and the automotive industry, however, the large-scale production of CFs is immensely limited by production costs. Numerous