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On the description of the orientation state in mesophase pitch-based carbon fibers

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Abstract: Due to its high oriented molecular structure and crystalline graphite content, the mesophase pitch is the main precursor of high-performance carbon fibers (HPCFs) with high Young's modulus and great thermal and electrical conductivity [1]. In this work, we propose a mesoscopic continuum approach for mesophase pitch-based carbon fibers, in order to describe how the mesophase regions orientation states can influence the behavior of the pitch in different flows. By using the continuity condition for the orientation distribution function (ODF) of the mesophase pitch, one can obtain a new homogenous non-linear evolution equation for ODF [2]. The finite element method solves the homogeneous non-linear equations. This work shows two-dimensional solutions only, although three-dimensional solutions are straightforward extensions. In the two-dimensional approximation, all mesophase regions are parallel to the shear plane. Thus, the angle between the shear direction and the mesophase region orientation completely specifies its orientation state. In general, the numerical solution for the new homogeneous non-linear equations proposed in the work shows orientation angle values strictly close to those experimentally obtained by Hamada *et al*. [3], indicating the accuracy of the approximation. All calculations were performed by the Mathematica software (version 11.1).

Key-words: Carbon fibers, Fluid dynamics, Orientation distribution, Mesoscopic continuum thermodynamics

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