FM15S_10440

XXI International Congress of Theoretical and Applied Mechanics
Warsaw, Poland, August 15–21, 2004

Flow and Crystallization of Holey, Compound, Optical Fibers

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A model of the flow, thermal field and crystallization of slender, axisymmetric, slender, holey, compound optical fibers is developed by means of asymptotic methods based on the slenderness ratio. The model accounts for the crystallization kinetics and molecular orientation through generalized Avrami and Kikutani equations and their effects on the momentum equations through a dynamic viscosity law that depends on the temperature in an Arrhenius fashion and exponentially on the degree of crystallization. For small Biot numbers, it is shown that the fiber's geometry, axial velocity component, temperature, molecular alignment and crystallization are governed by one-dimensional equations, whereas, at high Biot numbers, the thermal field is two-dimensional and the fiber's geometry and axial velocity component depend on the cross-section integrals of the viscosity. It is also shown that the fiber's necking, viscosity and molecular orientation increase whereas the crystallization decreases as the activation energy of the viscosity law is increased.

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