Electrorheological effect and non-Newtonian behavior of a homogeneous nematic cell under shear flow: Hysteresis, bistability, and directional response

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We study the flow of a homogeneous nematic cell under the simultaneous action of an applied electric field and an applied shear flow. Using a hydrodynamic model that describes the response of a flow-aligning nematic liquid crystal (5CB) we obtain the director's configuration and the velocity profile at the steady states. From these results we construct a phase diagram in the electric field vs. shear flow space that displays regions for which the system may have different steady-state configurations of the director's field. The selection of a given steady-state configuration depends on the history of the sample. Due to the competition between shear flow and electric field, the system's viscosity shows a complex non-Newtonian response with regions of shear thickening and thinning. Interestingly, as a consequence of the hysteresis of the system, this response may be asymmetric with respect to the direction of the shear stress. The results also show an important electrorheological effect which is also dependent on the history of the sample.

References (ACS format)
(1) J.C. Medina and Carlos I. Mendoza *Europhysics Letters* **2008**, *84*, 16002