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RHEOLOGICAL STUDY OF THE FLOW OF A BIOLOGICAL LIQUID CRYSTALS. (SPIDER SILKE SPINNING)

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In this work, the flow of a biologically-complex liquid (spider-silk) under pulsating and oscillating conditions is analyzed. This project proposes the description of the flow of the protein produced by spiders, in terms of a model that contains variables associated to characteristic material properties of the fluid (viscosities at low and high shear rates, relaxation and structural Maxwell times, elastic modulus and a kinetic constant). It is intended to develop a bio-mimetic fiber spinning process under benign environmental conditions by developing strategies that incorporate concepts such as self-assembly, confinement and rheology. The flow of this complex liquid (spider's protein) would be modeled using the Landau de Gennes nematodynamic equation. The rheological aspects of this work include complex fluids, liquid crystals, anisotropic viscoelasticity and complex oscillating and pulsatile flow with mass transfer. The combination of rheology and mass transfer under flow has scarcely been considered before, but it is a promising attempt to model this type of fiber-spinning process. Self-assembly under shear, a process used by spiders, opens up new processing routes in advanced bio-materials research. From a mathematical point of view, the problem contains elements of bifurcation theory, topology, non-linear dynamics, and pattern formation. From a computational point of view, multiscale solvers should be developed to solve multiple scales.