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Viscoelasticity and rheology of a suspension of active filaments[1]

M. CRISTINA MARCHETTI, Syracuse University, TANNIEMOLA B. LIVERPOOL, Leeds University, UK — We study the viscoelasticity of an active solution of polar biofilaments and motor proteins under an externally imposed stress. Adapting methods from polymer physics, we derive the constitutive equations for the stress tensor in the isotropic phase and in phases with liquid crystalline order (nematic and polarized). The stress relaxation in the various phases is discussed. Activity is responsible for a strong enhancement (a divergence in 2d) of the viscosity at the isotropic-nematic transition. This behavior is reminiscent of an equilibrium liquid-solid transition rather than a liquid-liquid transition, and is a direct consequence of contractile bundling. A second signature of activity is found in the nematic phase, where the stress tensor acquires a nonequilibrium contribution proportional to ATP (Adenosine Tri-Phosphate) consumption rate that remains finite in the absence of imposed mechanical deformation. The role of boundaries on these phenomena will also be discussed.

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