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Tuning the shear viscosity of a dilute suspension using particle shapes that inhibit rotation[1] NEERAJ SINAI BORKER, Sibley School of Mechanical and Aerospace Engineering, Cornell University, Ithaca, NY 14853, USA, ABRAHAM STROOCK, DONALD KOCH, Robert Frederick Smith School of Chemical and Biomolecular Engineering, Cornell University, Ithaca, NY 14853, USA — We show that a suspension of slender, rigid-particles that attain an equilibrium orientation in a simple shear flow have a much smaller intrinsic viscosity relative to a suspension of tumbling particles with the same aspect ratio. An axisymmetric particle, such as a ring or a fiber, with certain cross-sections can attain an equilibrium orientation in a low Reynolds number simple shear flow without application of external forces (Singh et al., *J. Fluid Mech.*, 2013; Bretherton, *J. Fluid Mech.*, 1962 a). These particles align such that the slender dimension(s) of the particle is/are almost perpendicular to the velocity gradient direction of the simple shear flow and thus they have much smaller stresslets compared to the time averaged stresslet of a rotating slender particle. While slender fibers, also remain aligned in a similar state for a long time, the major contribution to the average stresslet occurs when the fiber is flipping. Using slender body theory and boundary element method calculations we demonstrate that particle alignment could significantly reduce the intrinsic viscosity of the suspension relative to a suspension of rotating particles. By choosing particle shapes that can be fabricated using manufacturing techniques such as photolithography or 3-D printing, our results open new pathways to control the rheological properties of a particle suspension by altering the shape of the particle.

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