P.04 Dynamics of oblate and prolate capsules in shear flow

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The dynamics of oblate and prolate spheroidal capsules in simple shear flow with a small inertia is studied numerically for a range of dimensionless shear rates. The capsule is modelled as a liquid droplet enclosed by a hyperelastic membrane, and its equatorial plane is initially tilted out of the plane of shear. At low dimensionless shear rates, it is found the well accepted tumbling motion is not always stable for both oblate and prolate capsules. For an oblate capsule, the dominant stable modes for increasing dimensionless shear rate are as follows: rolling with the equatorial plane staying in the plane of shear, precessing following Jeffery's orbit [Proc. R. Soc. London A 102, 161 (1922)], and tumbling. Interestingly, the order of modes is reversed for a prolate capsule: tumbling, precessing, and rolling with increasing dimensionless shear rate. At transitional regimes, we find the stable motion of a capsule can depend on its initial titled angle, even at the same shear rate. At high dimensionless shear rates, a spheroidal capsule undergoes a complicated oscillating-swinging motion: Its major axis oscillates about the plane of shear in addition to the swinging about a mean angle with flow direction found previously, and the amplitudes of both oscillations decrease when increasing the dimensionless shear rate towards a steady tank treading motion asymptotically. The results are summarized in phase diagrams and the reorientations of both oblate and prolate capsules in a wide range of dimensionless shear rates are discussed.