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Flow of a Shear Thickening Micellar Fluid Past a Falling Sphere SHIJIAN WU, HADI MOHAMMADIGOUSHKI, Florida State University, FLORIDA STATE UNIVERSITY TEAM — In this work, we present the first quantitative measurements of a dilute shear thickening micellar solution past a falling sphere. The micellar solution consists of cetyltrimethylammonium bromide and 5-methyl salicylate (CTAB/5MS) in de-ionized water and it exhibits shear thickening behavior. This CTAB/5MS micellar solution forms un-entangled rod-like micelles at equilibrium. It is found that the drag coefficient for the falling sphere is similar to that of a Newtonian fluid at a vanishingly small Reynolds number ($Re = 0.03$). However, falling spheres experience a significant drag reduction for conditions that correspond to $0.09 \leq Re \leq 9.86$. Moreover, an unusually extended wake which spans over a long distance downstream of the sphere is detected by particle image velocimetry. These unusual results could be rationalized by invoking the phenomenon of flow induced structure formation. We hypothesize that strong shear and/or extensional flows around the falling sphere could trigger the aggregation of rod-like micelles into giant worm-like structures. Such worm-like micelles may induce significant sphere drag reduction and extended elastic wakes in the rear of sphere. This interpretation is consistent with the steady shear and transient extensional flow measurements.

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