Abstract Submitted
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Macroscopic Modeling of Micro-Inertia Effects in Multiphase Flows[1] ANTONY BERIS, PAUL MWASAME, NORMAN WAGNER, Univ of Delaware — A new approach to introduce micro-inertia into macroscopic models of multiphase flows is developed using the Non-Equilibrium Thermodynamics bracket formalism (Beris and Edwards, Thermodynamics of Flowing Systems, Oxford U. Press, 1994). The approach relies in the use on an internal contravariant conformation tensor variable to describe the multiphase micro-structure. Current applications include those of dilute emulsions, and concentrated colloidal suspensions. In the first case, the resulting constitutive equations are consistent with literature-developed asymptotic theories of the flow and deformation around isolated droplets in the limit of small capillary, Ca, and/or small particle Reynolds, Re, numbers. These asymptotic solutions are also used to uniquely determine all the model parameters. Structural predictions of the ellipsoid droplet morphology obtained with the new model are compared against classic experiments by Torza et al. (J. Colloid Interf. Sci., 38:395, 1972) and by Raja et al. (J. Fluid Mech., 646:255, 2010) showing good agreement. In the second case, the developed model significantly improves the conformation-based model developed by Phan-Thien (J. Rheol., 39:679, 1994) allowing for the prediction of both negative first and second normal stresses.

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