Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Effect of Eccentricity in Compound Droplets Subject to a Simple Shear Flow. SANGKYU KIM, SADEGH DABIRI, Purdue University — A double emulsion, or a compound droplet, is a system where two liquids are separated by an immiscible third liquid, thereby forming an emulsion inside an emulsion. Compound drops benefit from this separation in applications such food sciences, microfluidics, pharmaceutical engineering, and polymer sciences. While the subjects of double emulsion preparations, deformations, and breakup mechanisms are well-explored, the time-evolution of non-concentric compound drops has received far less analytical or computational scrutiny. In this work, we present computational results using finite volume method with front-tracking approach for initially spherical and non-concentric compound drops in a shear flow. Our findings for low Reynolds number flows show that: 1. The surrounding shear flow to the outer drop induces a rotational velocity field inside it, causing the inner drop to tumble with the flow, 2. the tumbling motion persists in time, and acts to increase the eccentricity of the compound drop, and 3. the hemisection-plane to the outer drop that is aligned with the plane of the simple shear defines an unstable equilibrium for inner drop's center, and the inner drop continuously drifts away from that plane. This work suggests a means of favorably configuring compound drops suitable for breakups, and helps to understand their migration in channel flows.

Sangkyu Kim
Purdue University

Date submitted: 01 Aug 2016 Electronic form version 1.4