Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

On a phase-field model for a miscible drop in a spinning drop tensiometer[1] ANDREA BOGHI, ANATOLIY VOROBEV, University of Southampton — We examine shape transformations of a solute droplet immersed into a solvent-filled and sealed capillary tube subject to fast rotations around its axis, i.e. the configuration of the spinning drop tensiometer. Despite the fact, that a droplet is miscible, its dissolution occurs rather slowly, and under rotations a droplet becomes elongated, which is used to measure the dynamic surface tension of the solute/solvent interface. The Boussinesq approximation [1] of the full (quasi-compressible) Cahn-Hilliard-Navier-Stokes is used as a theoretical model to capture the droplet evolution. We found that the behaviour of a miscible droplet contained in a closed enclosure is strongly different from an immiscible one. Miscible droplets in general are thermodynamically unstable and ultimately dissolve, large partially miscible droplets however may remain stable with the size determined by the total mass balance. In the limit of high Prandtl numbers, droplet's shape changes quickly (on a convective time scale), so that quasi- stable droplets are observed with only weak hydrodynamic flows present. Such states remain thermodynamically unstable: droplets lose their mass and the droplet's interface properties changes on a long diffusive time scale.

[1] A. Vorobev, PRE 82, 056312 (2010).

[1]The work is supported by the EPSRC grant No. EP/G014337.

Andrea Boghi
University of Southampton

Date submitted: 11 Aug 2011 Electronic form version 1.4