TIFR Centre for Interdisciplinary Sciences
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Seminar

Sessile droplet evaporation - Geometry-control and curvature-driven phase segregation in binary mixtures

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The evaporation of a sessile liquid drop is a remarkably common phenomenon. Yet, the complexity of the underlying mechanisms has constrained previous studies to spherically-symmetric configurations. We recently demonstrated (Sáenz et al, JFM, 772, 705) detailed evolution of thermocapillary instabilities during evaporation of hemispherical and non-hemispherical sessile droplets. Rigorous DNS (using our in house TPLS2 solver http://sourceforge.net/projects/tpls/) showed for the first time, breakage of symmetry and the consequent development of a preferential direction for thermocapillary convection. This results in counter-rotating whirling currents in the drop playing a critical role in regulating the interface thermal and fluid dynamics.

In this talk, I will present our recent investigations of well-defined, non-spherical evaporating drops of pure liquids and binary mixtures. We deduce a new universal scaling law for the evaporation rate valid for any shape and demonstrate that more curved regions lead to preferential localized depositions in particle-laden drops. Furthermore, geometry induces well-defined flow structures within the drop that change according to the driving mechanism and spatially-dependent thresholds for thermocapillary instabilities. In the case of binary mixtures, geometry dictates the spatial segregation of the more volatile component as it is depleted. In the light of our results, we believe that the drop geometry can be exploited to facilitate precise local control over the particle deposition and evaporative dynamics of pure drops and the mixing characteristics of multicomponent drops.

Tuesday, Dec 27th 2016

4:00 PM (Tea/Coffee at 3:45 PM)

Seminar Hall, TCIS