Finite-size Lagrangian coherent particle structures in thermocapillary liquid bridges

FRANCESCO ROMANO, HENDRIK KUHLMANN, TU Wien — A surprisingly rapid accumulation of small but finite-size particles taking curious shapes is observed in travelling hydrothermal waves in liquid bridges. The phenomenon has been termed particle accumulation structure (PAS) and belongs to the wider class of Lagrangian coherent structures. In PAS, particles are transferred from chaotic to regular regions of the flow by way of collision with the boundaries. Lubrication forces cause a dissipation of kinetic energy of the particle and give rise to particle motion attractors in the incompressible flow. Since the mechanism relies solely on the particle size, PAS is nothing but a finite-size Lagrangian coherent structure. Different theoretical models are investigated to find a minimum model for the simulation of Lagrangian finite-size coherent structures. Corresponding numerical simulations compare very well with experiments on SL-I and SL-II PAS.