

### **124c Diffuse Interface Modeling of Droplet Impact**

*Vinayak V. Khataavkar, Patrick D. Anderson, Paul Duineveld, and H. E. H. Meijer*

Impact of micron-size drops on flat, chemically homogeneous as well as on pre-patterned, chemically heterogeneous non-flat solid surfaces, under conditions relevant to inkjet printing of functional polymers, is studied using a diffuse-interface model. The diffuse-interface model applied is based on the Cahn-Hilliard theory and couples thermodynamics with hydrodynamics and is extended to include wetting effects i.e. non-90 degree contact angles. The axisymmetric model equations are solved numerically using a combination of finite and spectral element methods. For impact on a flat surface, the effect of various process/material parameters such as impact velocity, droplet diameter, viscosity, surface tension and wettability on the impact behaviour of drops is investigated. The overall effect of these parameters is better described in terms of the contact angle (measured through the droplet) together with dimensionless numbers viz. Reynolds number  $Re$  and Weber number  $We$  that appear naturally upon non-dimensionalization of the model equations. Depending on the values of  $Re$ ,  $We$  and contact angle, which for the cases considered here ranges from 1.3 to 130, 0.43 to 150 and 45 to 135 degree, respectively, the model predicts the spreading of a droplet with or without recoil or even rebound of the droplet, partially or totally, from the solid surface. When the droplet rebounds totally, it has a top-heavy shape. The maximum extent of spreading was found to depend mainly on the Reynolds number while the wettability was found to affect entire impact process. Keeping in mind the future applications of inkjet printing in plastic/polymer electronics impact on non-flat, pre-patterned solid surfaces was studied for two different configurations: (i) impact inside the circular cavity formed by a barrier and (ii) impact on the surface of disc-like barrier. The main idea was to investigate how the wettability contrast between the barrier and the base solid surface and the configuration of the barrier can be effectively used to confine the droplet to attain the desired shape. Accordingly, impact inside the cavity formed by the barriers, either with rectangular or curved cross-section, was studied with different wettability contrast between the barrier material and the base solid surface. Our results show that with the proper selection of the barrier wettability, the droplet can be contained inside the cavity. For impact on the disc barrier, the results suggest that a combination of high energy impact (to form a toroid) and a proper wettability contrast between the barrier and base solid surface (to retain it) may lead to a stable toroidal drop.