Numerical Simulation of Spreading Characteristics for Nanofluids Droplet

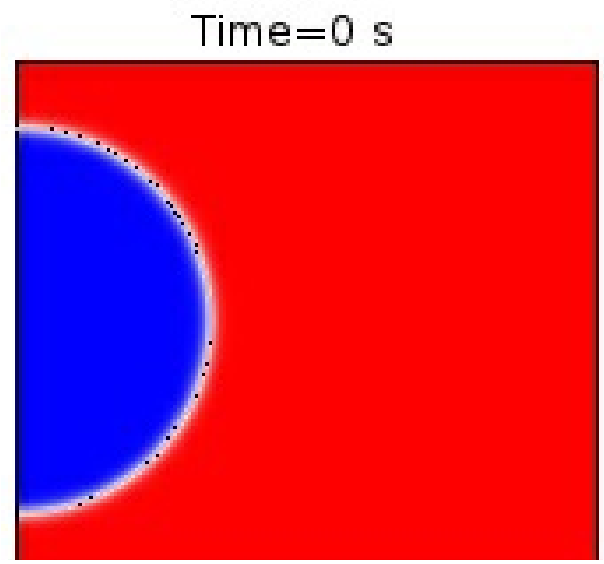
Hai-long Liu[1], Xue-feng Shen[1], Rui Wang[1], Yu Cao[1]

[1]School of Energy and Power Engineering, Jiangsu University, Zhenjiang, China

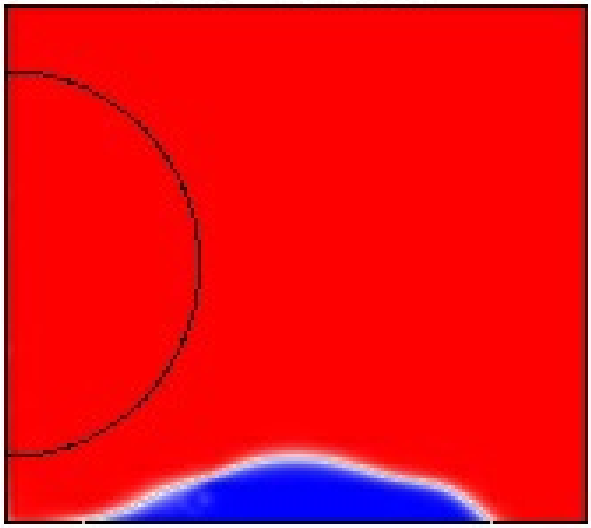
Abstract

The nanofluid is a class of fluids with high thermal conductivity and non-Newtonian flow behaviors. In this work, we present numerical simulations of spreading characteristics for nanofluids droplet impinging on the solid surface which is of great importance in a number of applications such as multiphase flows, corrosion of solid surface, thermal management, spray coating, ink-jet printing and others. In order to better understand spreading phenomena during the impinging process, the finite-element based scheme is implemented and evaluated and the level-set method is used for capturing the interface movement. All the simulations have been carried out with the interface 'Laminar Two-Phase Flow, Level Set' in the CFD Module of COMSOL Multiphysics® software. The case 'Rising Bubble' in the 'Application Libraries' has been referred to build the model to simulate the impinging process. The viscosity is measured at different shear rates and the shear-thinning behaviors of the nanofluids are incorporated to this study by employing the Carreau-Yasuda model. We investigate the evolution of droplet morphology during the spreading process under various Weber number of nanofluids with different viscosity. The results show that the degrees of shearing thinning in nanofluids are dissimilar and thus influence the spreading behaviors of nanofluids droplet. Specify the shear thinning behaviors suppress the spreading and rebounding stage of droplets during impinging and this suppression in nanofluids with large infinite shear viscosity is more prominent.

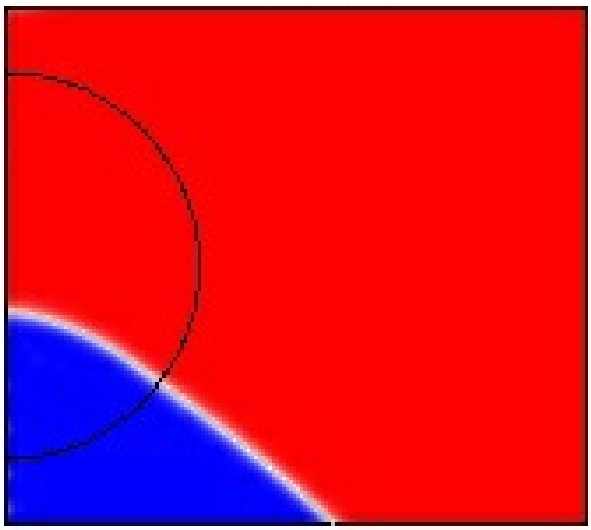
Figures used in the abstract



Time=0 .025s



Time=0.05s



Time=0.8s

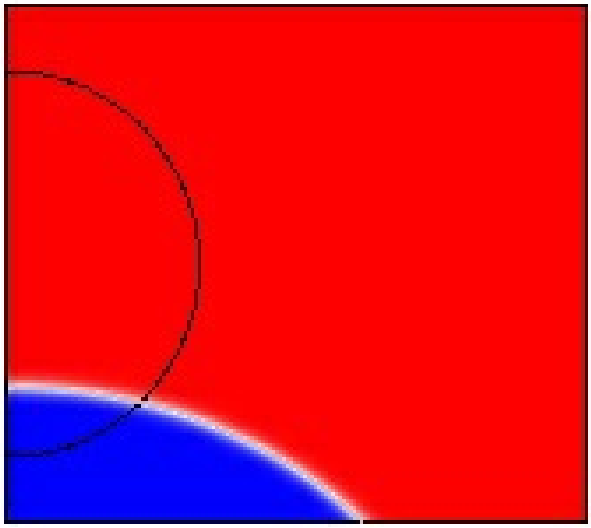


Figure 1: Time evolution images for droplet impinging on soild surface