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Numerical simulation of contact line motion and particle distribution in dip coating[1] GIHUN SON, JAEWON LEE, Sogang University — A level-set method is presented for computing contact line motion and particle distribution in dip coating, which is a popular process for production of thin films and has received new attention as a simple particle deposition process for patterning microstructures. Assuming that the interface temperature is below the saturation temperature, we solve the conservation equations of mass, momentum, and energy in the liquid-gas phases, the vapor mass fraction in the gas phase, and the particle concentration in the liquid phase. To consider the case where the particle concentration reaches the maximum value (in random packing), the diffusion coefficient of particles is determined from the generalized Stokes-Einstein equation. The temperature and vapor fraction at the interface and the evaporation mass flux are simultaneously determined from the coupled equations for the mass and energy balances at the interface and the thermodynamic relation. The present computations demonstrated that the plate withdrawal velocity significantly affects the liquid film formation and particle distribution pattern. In the regime of a low plate velocity, the computed liquid-gas-solid contact line reaches a quasi-steady state and the particle accumulation is pronounced near the stationary contact line.

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