Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Simulation of microdroplet manipulation on flat surface actuated by wettability gradient using dissipative particle dynamics[1] ZHEN LI, GUOHUI HU, ZHEWEI ZHOU, Shanghai Institute of Applied Mathematics and Mechanics, Shanghai University — A particle based mesoscopic methodology called dissipative particle dynamics (DPD) is utilized to simulate the manipulation (translation and coalescence) of micro-droplets in planar microfluidic chips with gradients of wettability. The three dimensional velocity field of a moving droplet propelled by wetting gradient is presented, which shows that the liquid spreads downwards onto substrate in the front area while it converges upwards in the back. The flow structure reveals that the drop moves in a combination of rolling and translation, and the rotation could be dominant when the contact angle is bigger than about 110°. The increasing of the gradient steepness and the size of droplet, as well as the magnitude of thermal fluctuation, is capable to significantly accelerate the movement for a sub-micrometer droplet. The liquid mixing in coalescence of two droplets is investigated as well. It is found that the process of mixing consists of two stages — a rapid active mixing through convective mass transfer and then a slow passive mixing through diffusion, which is consistent with previous experiment. Results also indicate that the thermal fluctuation is helpful to promote the coalescence and liquid mixing.

[1]The work was supported by the NSF of China (Grant No. 10872122).

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Date submitted: 05 Aug 2011 Electronic form version 1.4