Electrical Field Dependent Droplet selector

Xu Deng[1*], Dehui Wang[1], Longquan Chen[2]and Hong-Ren Jiang[3*]

[1.]Institute of Fundamental and Frontier Sciences, University of Electronic Science and Technology of China, 610054, Chengdu, China

[2.] School of Mechanics and Engineering, Southwest Jiaotong University, 610031 Chengdu, China

[3.]Institute of Applied Mechanics, National Taiwan University. No.1, Sec. 4, Roosevelt Rd., Da'an Dist., Taipei City 106, Taiwan (R.O.C.)

Email: dengxu@uestc.edu.cn; Tel.: +86-28-83204100

Dynamics of drops on surfaces are important for the basic understanding of various processes, ranging from daily life to cooling and coating. Recently, lab-on-a-drop rises attentions, because various functions of traditional chemical processes can be achieved this technique. Thus, controllable behaviors of drops on surfaces are desirable. The dynamics and interactions between drops and the superhydrophobic surface have been intensively studied in recent years. Various kinds of interactions, including rebounding, jumping, self-clearing, and cooling have been reported. Controlling the interaction between the drop and the solid surface is the key of these phenomena. Several studies utilizing the electric wetting have been demonstrated in hydrophobic surfaces and superhydrophobic surfaces. However, the present of an electrode within a drop may limit its applications. To overcome this problem, dielectric wetting[6,7] has been proposed and realized in different conditions mainly for actuation. In this study, we show rebounding of drops controlled by electric field may be realized by dielectric wetting, which may enable new applications.[1-5] In this work, Electric field effect on liquid drop rebounding is studied in interdigitated array (IDA) electrodes covered with superamiphiphobic coating under AC field. Coefficients of restitution are measured in different applied voltages. The results show that a medium voltage applied on IDA (~ 30V) can effectively change the drop rebounding on the IDA surface. We also directly measured the adhesive force curves and contact angles of drops on IDA under different voltages. The results suggest that only small fraction of the drop is tightly pinned on the surface while the other parts of the surface remain superhydrophobic. This new method of controlling liquid-solid interaction may enable new drop based microfluidic applications. A simple control of drop rebounding distance is also demonstrated.

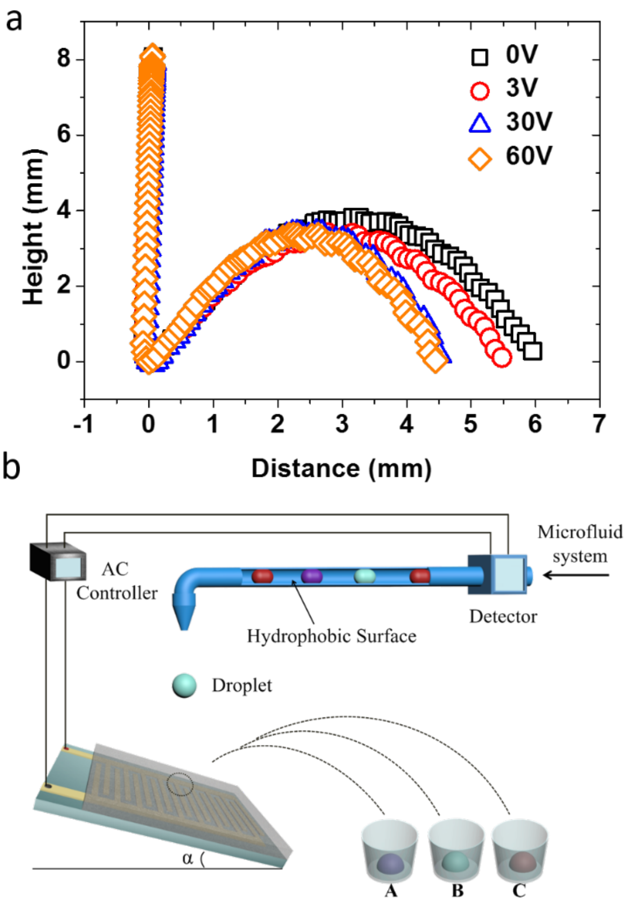

Figure 1. a) The effect of applied voltage on bouncing distance. b) The cartoon of droplet selector mechanism.

Reference:

1. Neil J. Shirtcliffe, Glen McHale, Shaun Atherton, and Michael I. Newton, Advances in Colloid and Interface Science **161** (1–2), 124 (2010).
2. Mugele Frieder and Baret Jean-Christophe, Journal of Physics: Condensed Matter **17** (28), R705 (2005).
3. G. McHale, C. V. Brown, M. I. Newton, G. G. Wells, and N. Sampara, Physical Review Letters **107** (18), 186101 (2011).
4. Thomas B. Jones, Langmuir **18** (11), 4437 (2002).
5. Xu Deng, Lena Mammen, Hans-Jürgen Butt, and Doris Vollmer, Science **335** (6064), 67 (2012).