Electrowetting Actuation of Polydisperse Nanofluid Droplet

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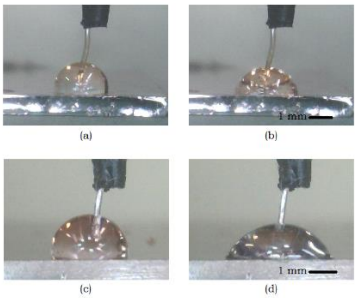
Abstract (300 word limit)

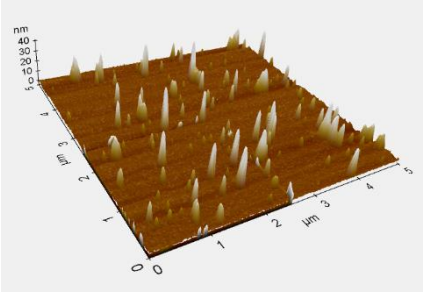
We present results of electrowetting experiments employing droplets formed from aqueous suspensions of gold nanoparticles. A planar electrowetting system, consisting of a platinum wire electrode and a bottom copper electrode with an insulating silicone (polydimethylsiloxane) layer, is used to observe changes in droplet contact angle when an external electric field is applied. The equilibrium contact angle at 0V decreases with increasing nanoparticle concentration, dropping from100.4◦ for pure deionized water to 94.7◦ for a 0.5 μM nanofluid.

Increasing the nanoparticle content also lowers the required voltage for effective actuation. With actuation at 15V, contact angle decreases by 9% and 35% for droplets formed frompure water and a 0.5μM nanoparticle suspension, respectively. Contact angle saturation is observed with nanofluid droplets,with the threshold voltage decreasing as nanoparticle concentration rises.Maximum droplet actuation before contact angle saturation is achieved at only 10V for a concentration of 0.5 μM. A proposedmechanism for the enhanced electrowetting response of a nanofluid droplet involves a reduction in surface tension of the droplet as nanoparticles accumulate at the liquid-vapor interface.

Image



Change in droplet curvature and base diameter due to electrowetting actuation for deionized water: (a) at 0 V; (b) at 10 V. For a 0.5 µm nanofluid droplet: (c) a smaller contact angle at 0 V and (d) an enhanced electrowetting response at 10 V are observed



Atomic force microscopy (AFM) image of the synthesized gold nanoparticles

Recent Publications (minimum 5)

1. Zhao YP, Wang Y (2013) Fundamentals and applications of electrowetting: a critical review. Reviews of Adhesion and Adhesives, 1(1): 114-174.
2. Shamai R, Andelman D, Berge B, Hayes R (2007) Water, electricity, and between. . . On electrowetting and its applications. *Soft Matter*, 4(1): 38–45.
3. Chakraborty D, Sudha GS, Chakraborty S, DasGupta S (2011) Effect of submicron particles on electrowetting on dielectrics (EWOD) of sessile droplets. *Journal of Colloid and Interface Science*, 363(2):640–645.
4. Dash RK, Borca-Tasciuc T, Purkayastha A, Ramanath G (2007) Electrowetting on dielectric-actuation of microdroplets of aqueous bismuth telluride nanoparticle suspensions. *Nanotechnology*, 18(47).
5. Martin MN, Basham JI, Chando P, Eah SK (2010) Charged gold nanoparticles in non-polar solvents: 10-min synthesis and 2D self-assembly. *Langmuir*, 26(10): 7410–7417.
6. Guerrero RA, Mero RDC (2014) Electrowetting actuation of a dye-doped fluorescent droplet. *Nanophotonics and Micro/Nano Optics II*, vol. 9277 of *Proceedings of SPIE*, Beijing, China.
7. Vafaei S, Purkayastha A, Jain A, Ramanath G, Borca-Tasciuc T (2009) The effect of nanoparticles on the liquid-gas surface tension of Bi2Te3 nanofluids. *Nanotechnology*, 20(18), Article ID 185702.

Biography (150 word limit)

Crismar P. Patacsil received his MS degree in Physics at the University of the Philippines Diliman, Quezon City in 2004 and is currently a PhD student at Ateneo de Manila University under Dr. Rapahel Guerrero as his dissertation adviser. Dr. Guerrero is also currently the Chair of the Department of Physics at Ateneo de Manila University (ADMU), Philippines. Dr. Erwin Enriquez is a faculty at the Department of Chemistry at ADMU. Currently, C. Patacsil is an Assistant Professor of the Department of physical Sciences, College of Science at University of the Philippines Baguio , Baguio City.

Raphael A. Guerrero received his PhD degree in Physics from the University of the Philippines Diliman in 2005. Currently, he is an Associate Professor f the Department of Physics, Ateneo de Manila University. He served as president of the Physics Society of the Philippines in 2011 and 2012. He was a recipient of the World Academy of Sciences for Yung Scientists in Developing Countries in 2013. He is a member of SPIE and OSA.

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