

課題番号 : F-15-UT-0072  
 利用形態 : 機器利用  
 利用課題名(日本語) :  
 Program Title (English) : Electric Instability of Cassie Droplets on Super-Lyophobic Pillar Surface: Pull-in Versus Electrowetting  
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## 1. 概要(Summary)

We have investigated the micro-scale topology of the liquid-air interface during the Cassie-to-Wenzel transition under electric field both from modeling and experimental approaches. A force-balance model has been developed to find the critical voltage under electrostatic force. The change of liquid-air interface over the super-lyophobic pillared surface was experimentally captured. We have obtained a geometrical boundary that identifies the two instability modes of the Cassie-to-Wenzel transition: 1) pull-in and 2) electrowetting. The validity of the present model has been demonstrated by a series of experiments.

## 2. 実験(Experimental)

### 【利用した主な装置】

高速大面積電子線描画装置 (ADVANTEST F5112+VD01)、高速シリコン深掘りエッチング装置 (SPTS MUC-21 ASE-Pegasus 4”装置)、汎用 ICP エッチング装置 (ULVAC CE-300I 4”装置)

### 【実験方法】

The fabrication of the present super-lyophobic surface includes the equipments of EB-lithography to pattern the mask for pillared surface, CE-300I for CHF<sub>4</sub> plasma etching of SiO<sub>2</sub>, and the MUC-21 for deep etching of pillar structures. The fabrication process is followed by oxidation of Si and coating of hydrophobic layer.

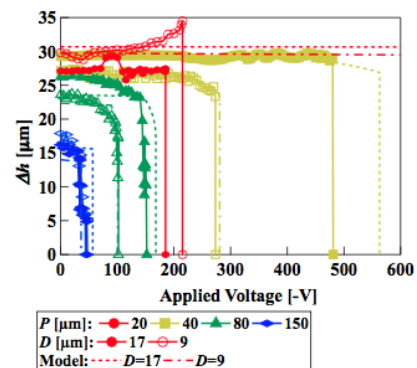


Fig. 1 Change of the liquid-air interface under electric fields.

## 3. 結果と考察 (Results and Discussion)

Voltage was applied across the backside of Si substrate and a ITO glass on top of 0.5 μL glycerol droplet. Figure 1 shows the measured distance between the liquid-air interface and the substrate at the center of the pillar array under electric field. Model lines are also plotted for comparison. The boundary of the two competing modes for the instability, i.e., pull-in of the interface and electrowetting mode, has been obtained and validated against experimental results.

## 4. その他・特記事項 (Others)

なし

## 5. 論文・学会発表 (Publication/Presentation)

• Chen, Y.-C., Morimoto, K., and Suzuki, Y., 29th IEEE Int. Conf. Micro Electro Mechanical Systems (MEMS'16), Shanghai, (2016), pp. 137-140.

## 6. 関連特許 (Patent)

なし