Electric-field Assisted Vertical Injection of Micro-spheres for E-paper

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Our previous investigation on injection method of conductor coated polymer ball (CCPB) inside fast-moving ball actuator (FMBA) device has shown remarkable performance on aligning CCPB on a large scale.[1, 2] In spite of its fine function, it had issues on losing few CCPB on every proceeding steps and some physical damages during the rubbing process. To avoid these issues, we have been researching on self-alignment of micro-spheres based on dielectrophoresis (DEP) and injected into FMBA device by vertically formed electric-field. Inevitably, electric-field distribution depends on electrodes patterned on DEP and FMBA devices. In order to optimize the injection condition, behavior of CCPB in such electric-field was studied. Electrical force applied on CCPB is consisted of induced charge, Q=CV, and external electric-field. Different electrode sizes were prepared to clarify the effect of capacitance, $C \sim \varepsilon_o \varepsilon_r A/d$, formed in a cell as shown in Fig. 1. From experimental results of vertical injection, movement of CCPB clearly had threshold voltage and depended on electrode area (A) and gap of a cell (d). Some abnormal behaviors of CCPB were observed as electrode area increased. There were frequent mis-alignment of CCPB and sometimes it moved horizontally. It can be comprehended that as electrode area increases, electric-field is not confined to limited area and therefore CCPB was able to move to any spot. And also, the gradient of electric-field may have effected CCPB to move horizontally by a negative dielectrophoresis.

For our original purpose, we expanded its vertical injection sites to 1096x352 array (Fig. 2) and optimizing injection condition is on proceeding.

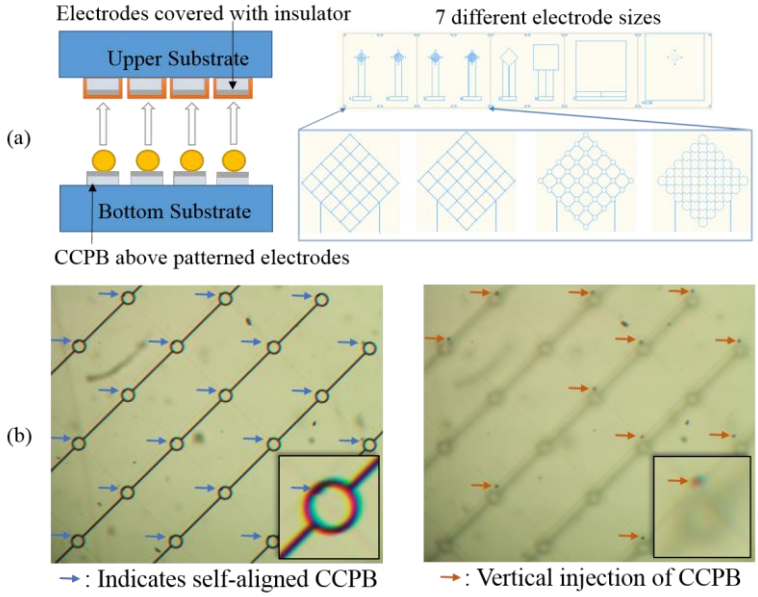

Fig. 1 (a) Vertical injection cell and different sizes of electrodes to clarify the effect of capacitance, (b) Experimental results of vertically injected CCPB.

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References

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