Self-alignment of Micro-spheres Base on Dielectrophoresis

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We have been researching on individual micro-sphere alignment technology in order to fabricate conductor coated polymer ball (CCPB) based e-paper.[1] Using a positive dielectrophoretic force (p-DEP)[2], we were able to demonstrate alignment of micro-spheres in 3x3 array as shown in Fig. 1. We made a colloid suspending CCPB (AU-215, Sekisui) 5 g in silicon oil (KF-96 100cs, Shinetsu) 50 ml. It was injected and passed through a micro-channel cell using micro-fluidic system. Although we expected p-DEP to be induced on CCPB in any frequency range due to the permittivity and conductivity of our colloid, self-alignment was presented under 1 kHz. Considering electric properties of the silicon oil represented in a technical report to be correct, and since conductivity of CCPB were not from Sekisui, but using commonly accepted value, we may have overestimated conductivity of nano-thick Au. And also, nano-sized defects on CCPB would let core polymer appear above its surface which has $\varepsilon_r \sim 3$. Assuming conductivity of nano-thick Au to be 4×10^4 S/m and relative permittivity 3, calculation showed that magnitude of p-DEP decreases after 1 kHz. In low frequency range, unnecessary remaining CCPB was observed none the less p-DEP was confined to a center of dot-ring pattern. In spite of high fluid speed, this unpleasant was still remaining and we assumed it due to very strong Coulomb force and adhesion.

For our original purpose, we have expanded its size to 1096x352 array (Fig. 2) and self-alignment experiment on a large scale is on proceeding.

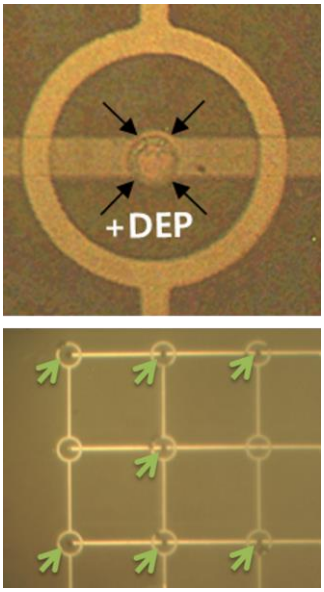

Fig. 1. 3x3 array device for p-DEP self-alignment

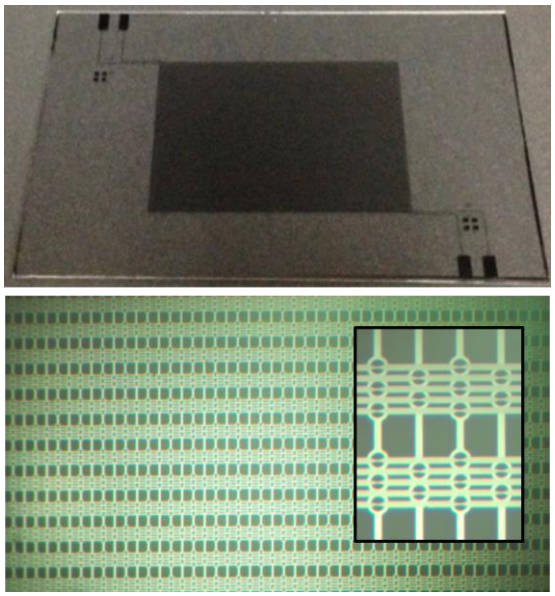

Fig. 2. Largely expanded self-aligning device

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References

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