

Imaging of Magnetic Nanoparticles Added in Transformer Oil According to the Electric and Magnetic Fields

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The phenomenology of liquid breakdown has been an area of interest for many years but is still not fully understood. Moreover, it was known that the behavior of magnetic nanoparticles in transformer oil could affect the dielectric breakdown voltage positively or negatively. In this study, we have imaged the magnetic nanoparticles in a transformer oil in-situ using an optical microscopic set-up and a microchannel according to the electric and magnetic fields applied. And we have calculated numerically dielectrophoresis and magnetophoresis forces, which must be the driving mechanisms to move magnetic nanoparticles in the fluid. It was found that when the electric field is applied the magnetic nanoparticles in the fluid experience an electrical force directed toward the place of maximum electric field strength. And when the external magnetic field is applied, the magnetic nanoparticles form long chains oriented along the direction of the field.

Keywords: Magnetic nanoparticle (자성나노입자), Dielectrophoresis (유전영동), Magnetophoresis (자기영동), Microchannel (마이크로 채널)

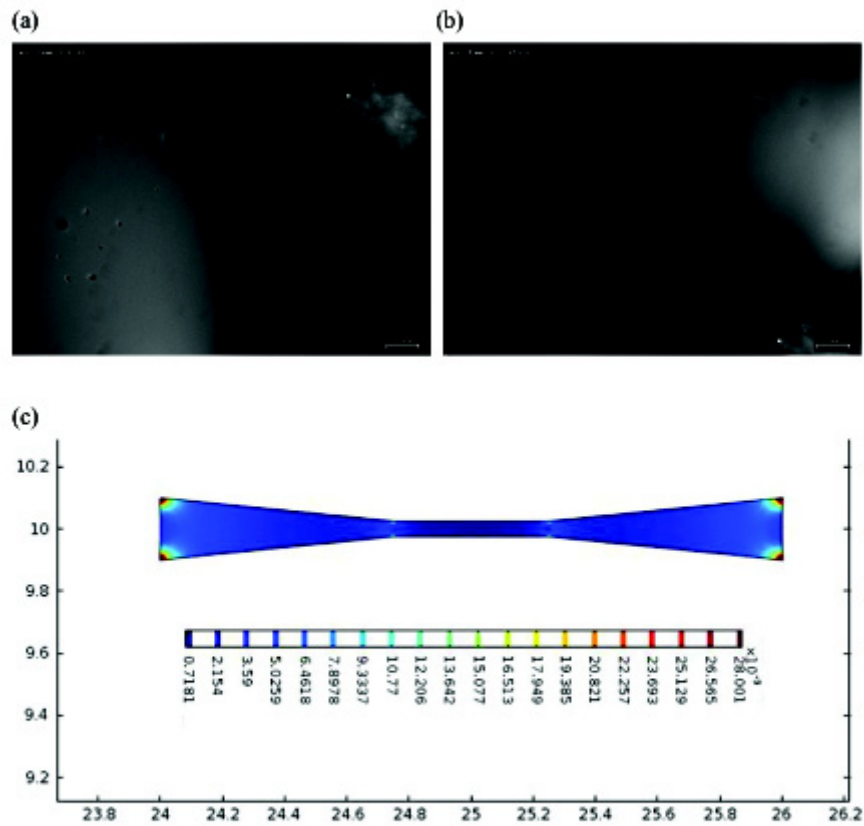


Figure. Optical microscopic results (a) in the case not applied both fields and (b) in the case applied the electric field (2.5 kV). (c) Distribution of the calculated dielectrophoresis force in a microfluidic chip.