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Calculations of dielectrophoretic forces on non-homogenous dielectric particles with different shapes

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Dielectrophoresis has become a very important tool in the aspect of utilizing microscopic dielectric particles in recently years. More and more developments have been achieved in various subjects, such as: chemistry, life science, astronomy and engineering. In these developments, manipulation of these small dielectric particles is the main problem due to quantifying FDEP (dielectrophoretic forces). Point-Dipole (PD) and Maxwell Stress Tensor (MST) methods are commonly used for quantifying in current researches. PD method is a simplified way which can be used in the condition that particles are all homogenous and spherical, while their existences don't change external electric fields. MST method is a more exact way for the calculation which is able to consider particles'shape and the deformation of particles to external electric fields, however, it is limited to homogenous particles. In order to overcome the limitations above, a new method VEM (Volumetric Element Method) was introduced into the calculation. With the method, FDEP on a homogenous and non-homogenous particles with different shapes (sphere, ellipsoid, square) were calculated under an electric field. Differences among the three methods are compared and analyzed. Finally, it was found that PD method is not suitable when the deformations of particles on external electric fields were very strong, but VEM and MST still kept a good performance. What's more, it indicated that variations of shapes and homogeneity changing the volume and dielectric constant of particles would influence FDEP acting on particles.

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