Particle Concentration Effect on Dielectrophoretic Trapping

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Abstract

Dielectrophoresis (DEP) is an electric field driven technique that has important applications in the enrichment, concentration and isolation of biological and non-biological particles. The assessment of particle trapping capacity using DEP, however, has been qualitative in nature; since current mathematical models are in an early stage and more sophisticated models are under development [1]. Recent studies have shown a significant difference between the calculated DEP force and the experimental DEP force observed in a real system [2]. In most cases, a correction factor that matches experiments and simulations is employed to provide a more realistic description of the studied system [3]. While some hypothesis can be found in literature to explain the origin of this correction factor (e.g., distortion of the electric field induced by particles, interaction between particles, variations in the local permittivity in the band of trapped particles), its origin is still uncertain [3].

This contribution presents a systematical study of the correction factor as a function of particle concentration to elucidate possible mechanisms that give rise to a significant deviation from theory; the correction factor was estimated by matching the experimental DEP force in a tampered microchannel with numerical simulations. The numerical simulations consisted on solving the Laplace equation within the AC/DC Module of COMSOL Multiphysics® software to estimate the distribution of the electric field, as well as the particle net force and velocity, in the tampered channel.

Since a tampered channel results in a linear increasing of the electric field in the flow direction, several applied electric potentials were studied so as to discern equilibrium points in particle velocity. These equilibrium points were used to accurately estimate the correction factor and its underlying generating function.

Reference

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