Trapping DNA Molecules in Fluids Using Electrokinetic Effects Generated By Different Electrode Geometries

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Introduction: The facilitation of trapping of DNA molecules in which they are suspended in a solution is possible by having control over two main electrokinetic forces AC-electroosmosis(ACEO) and Dielectrophoresis(DEP) [1]. We present our investigation in terms of computationally simulated results for triangular convex and triangular concave electrodes.

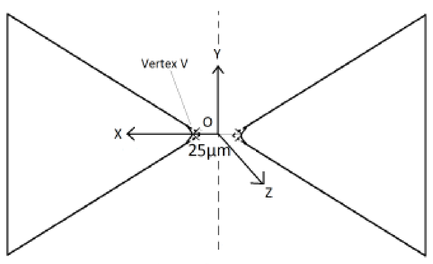

Figure 1. Top view of Convex Triangular Geometry

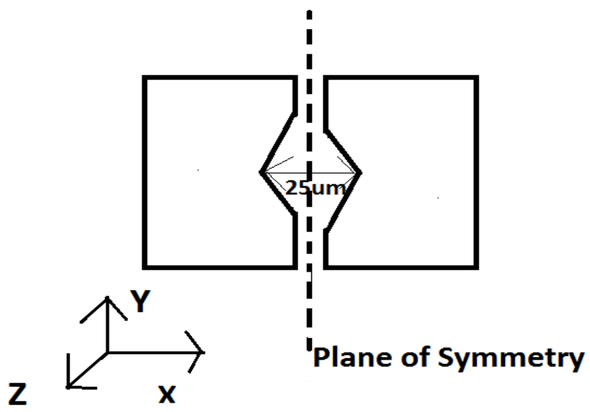

Figure 2. Top view of Concave Triangular Geometry

Computational Methods: The governing equations for electro-kinetic forces given by;

$F_{dep} = 2\pi\varepsilon_m R^3 Re[K(\omega)] \nabla|E_{rms}|^2$

where *R* is the radius of the particle[2]. The Cartesian components of flow velocities *(u, v, w)* have been calculated by solving the Navier Stoke's equations[3].

Results: Following were the force plots obtained.

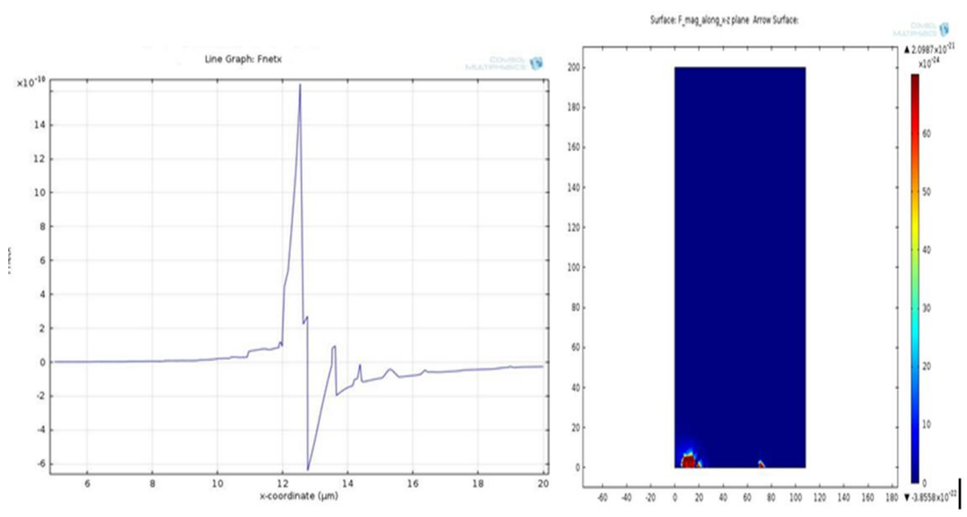

Figure 3. (Left)Plot of x component of Force versus x for the case of convex electrodes. (Right)Magnitude of the force on the x-z plane.

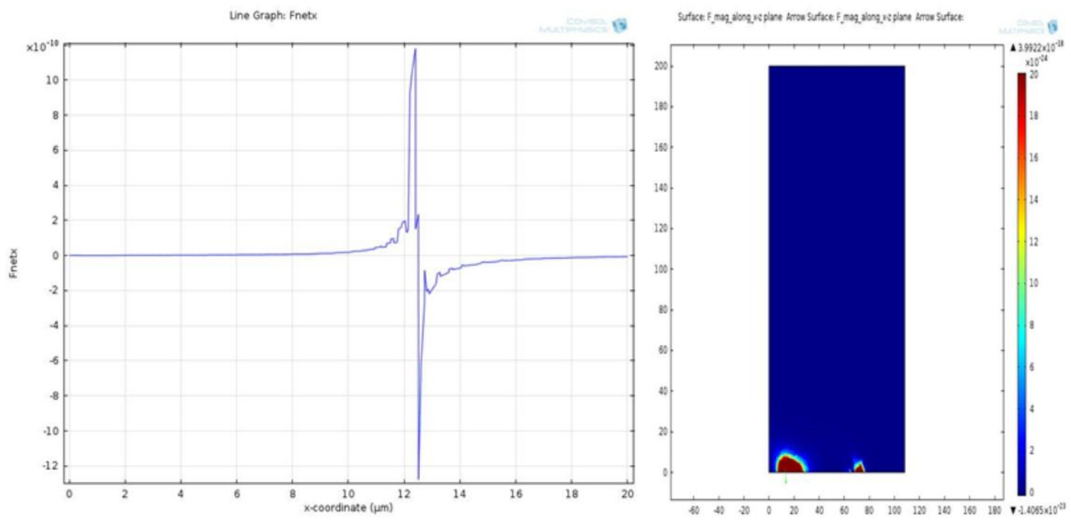

Figure 4. Figure 3. (Left)Plot of x component of Force versus x for the case of concave electrodes. (Right)Magnitude of the force on the x-z plane.

Conclusions: We conclude that a trapping point exists where X and Y component of the net force is vanishing. The non zero component of the force which is in the negative Z direction pushes the particle down towards the electrode.

References:

1. M. Hernandez et al. "Insulator-based dielectrophoresis of microorganisms: Theoretical and experimental results." Electrophoresis 32 (2011) 2502.
2. R. Pethig, "Review article—dielectrophoresis: status of the theory, technology, and applications." Biomicrofluidics 4.2 (2010): 022811.
3. B-J Kim, "Simulation of an ac electro-osmotic pump with step microelectrodes." Physical Review E 83.5 (2011): 056302.

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