ELECTRIC TWEEZERS: EXPERIMENTAL STUDY OF POSITIVE DIELECTROPHORESIS BASED POSITIONING AND ORIENTATION OF A GOLD NANOROD

Edwards, B.E.[1], Evoy, S.[2], Engheta, N.[1]
[1]Dept. of Electrical and Systems Engineering, University of Pennsylvania, Philadelphia, PA 19104, USA
[2]Dept. of Electrical and Computer Engineering and National Institute for Nanotechnology, University of Alberta, Edmonton, AB T6G 2V4, Canada

The manipulation of individual micrometer-sized objects has been the focus of significant research efforts over the last few years. We first briefly review a method that we had analyzed earlier to arbitrarily move and orient a prolate conductive particle such as a gold nanorod in the region between a set of electrodes using positive dielectrophoretic forces. Each electrode is approximated as a set of sources, namely an unknown point charge and induced dipole. Imposing constraints on the electric field at the location of the particle and requiring self-consistency uniquely determines the sources. They can then be subsequently used to determine the set of electrode voltages that creates an electric field that will produce the prescribed orientation and force on the particle. Compared to the idealized single medium geometry in this derivation, the experimentally realizable geometry in our current work requires both a substrate to support the electrodes and a fluid to suspend the particle. Here, we discuss the electrostatic consequences of these complications. We demonstrate an experimental apparatus that implements the theory and discuss its parameters and constraints. The drag coefficients of a gold nanorod are determined by sequentially applying a constant force both parallel and perpendicular to its axis and observing the resulting motion. With the drag coefficients in hand, the velocity rather than force can be prescribed, and the rod is directed to accurately move at oblique angles to its orientation. The rod is in a constant state of unstable equilibrium and requires negative feedback to maintain a fixed position. This is most easily done by computer. We demonstrate that this can be automated and program a nanorod to travel over a complex path.

Abstract Submission Form

2006 National Radio Science Meeting

Abstract: edwards17762

Date Received: September 19, 2005

1. (a)
Brian Edwards
Rm 203 Moore Building
ESE Dept Office
200 S. 33rd Street
Philadelphia, PA
19104 USA
brianedw@seas.upenn.ed
   (b) 215 898 1438
   (c)
2. B - Fields and Waves
3. (a)
4. C - Contributed Paper
5. No special instructions