Intracellular Dielectric Tagging for Improved Optical Manipulation of Mammalian Cells

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ABSTRACT

Optical micromanipulation of transparent microparticles such as cellular materials relies upon the application of optical forces that are crucially dependent on the refractive index contrast between the particle and the surrounding medium. We briefly review the application of optical forces for cell manipulation and sorting, highlighting some of the key experiments over the last twenty years. We then introduce a new technique for enhancing the dielectric contrast of mammalian cells, which is a result of cells naturally taking up microspheres from their environment. We explore how these intracellular dielectric tags can influence the scattering and gradient forces upon these cells from an externally applied optical field. We show that intracellular polymer microspheres can serve as highly directional optical scatterers and that scattering forces can enable sorting through axial guiding onto laminin-coated glass coverslips upon which the selected cells adhere. Such internal dielectric tagging presents a simple, inexpensive, sterile technique to enhance optical manipulation procedures for cellular material and may enable new sorting techniques within microfluidic systems