Non-Invasive Optical Method for Manipulating Cell Motility, Differentiation and Patterning

Advantages
- Able to guide the dynamics of large groups of cells in a non-invasive manner
- Utilizes low-intensity light that does not endanger the cell’s viability
- Able to perform cell deformation
- Allows for cellular displaced in three dimensions

Invention
Methods for regulating cell motility and cell differentiation based on the action of irradiation with polarized light

Background
The invention introduces an effective non-invasive optical method for regulating cell motility and cell differentiation using optical torques exerted by linearly polarized light. In biology, the use of radiation forces for such manipulation has been common practice, but the use of optical torque exerted by linearly polarized light is a first! Moreover, the present innovation is not simply limited to cell displacement and division, but can also perform other forms of manipulations, such as cell displacement in three dimensions, cell rotation and cell deformation without actual displacement of the cell. Such guiding, manipulating or aligning of cells can all be achieved using low levels of irradiance such that the cells’ viability is not compromised.

Cell migration, or the ability to guide cells from one part of the body to another, is the biological method which controls immune cell homing, wound healing and axonal path finding. Although different cell types have unique approaches to cell movement, overall cell migration is a physically integrated molecular process. Having the control over the shape, position and/or movement of living cells, would be extremely useful for a variety of clinical, diagnostic and therapeutic applications. Various light-based methods have been proposed in the past which enable the manipulation of very small objects. Said methods have the potential to be used to move cellular sized objects, but they require the use of highly-focused high-intensity light which can damage and even kill living cells.

Application
The invention can displace multiple cells at the same time in different directions, bringing cells next to or away from one another. Such capabilities could aid in understanding how specific drugs affect communications between cells. Besides offering unique capabilities for laboratory analysis and drug development, this invention is applicable to a variety of clinical, diagnostic and therapeutic uses. Such application could include wound healing, tissue generation, prevention of degenerative diseases and inhibition of metastasis. Recent advances in stem cell technologies that depend substantially on the ability to control the differentiation and migration of cells can also benefit from this invention.

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Selected Reference