

Viscoelastic Fluids-based Microfluidic Devices and Applications

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Manipulation and separation of micro/nano-objects such as cells are indispensable and crucial in disease diagnostics, environmental science, and chemical and biological assays. Microfluidic techniques have emerged as efficient and powerful tools for particle/cell manipulation due to their unique advantages of lower cost with higher efficiency and accuracy. However, most of these manipulating methods are performed and studied in Newtonian fluids (whose viscosity does not change with the flow conditions such as water). In fact, non-Newtonian fluids (whose viscosity changes with the flow conditions leading to unique properties) such as blood, saliva, cytoplasm, and many other body fluids, are very ubiquitous in our daily life and in real world issues. Therefore, it is important to investigate particle migration in non-Newtonian fluids to develop a deep understanding of cell behaviours in these body fluids. The unique advantages of particle/cell manipulation using viscoelastic microfluidics were explored, and cutting edge microfluidic technologies for particle and cell manipulation including 3D particle focusing, separation and on-chip cell washing was developed, and their usefulness in both environment and biomedicine was demonstrated.