High-Throughput Enrichment of Micro-Nanoplastic Using Inertial Microfluidics

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Abstract

The increasing presence of micro- and nanoplastic in water is threatening human lives, animals, and environment. The samples collected from drinking water and water sources have to be analyzed to realize the effect of micro- and nanoplastics. Inertial microfluidics, as a passive particle manipulation technique, can help enriching the particles for further downstream analysis. Inertial microfluidics is a phenomenon where randomly distributed particles migrate and find their equilibrium positions within the microfluidic channel. Inertial focusing of particles can separate the particles from each other and sort them based on their sizes.

The forces that are applied on the particles in water depend on the particle's size and they eventually define the position of the particles in the channel. Therefore, the particle manipulation based on particle's sizes can be achieved with well-understood and well-designed microfluidic channels. In this study, the fluorescent labelled polystyrene beads with the size of 8 and 10 μm are focused in one position using spiral microfluidic channel which employs the combination of lift force and Dean drag force. The balance of these two forces pushes the particles towards the inner wall of curved channel in a single focusing position in high-aspect ratio channels. If the different sized focused particles are introduced with another curve in the channel, the smaller particles move towards the outer wall while the larger particles stay at the inner wall. Calculating the optimum flow rate that moves smaller particles, but not larger particles is key. Here, we present successful separation of 8 and 10 μm particles at 250μL/min. The same concept can be used for separating smaller particles by scaling down the microfluidic design.

Inertial microfluidics can be used for high-throughput enrichment of micro- and nanoplastics from water without the need of any external sources that can improve the further downstream analysis.

Keywords: inertial microfluidics, high throughput, microplastics, nanoplastics, separation, enrichment

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