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Structural Parameter-Induced Focusing Pattern Transformation in CEA Microfluidic Device

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Abstract : The contraction-expansion array (CEA) microfluidic device is widely used for particle focusing and particle separation. Without the introduction of external fields, it can manipulate particles using hydrodynamic forces, including inertial lift forces and Dean drag forces. The focusing pattern of the particles in a CEA channel can be affected by the structural parameter, block ratio, and flow streamlines. Here, two typical focusing patterns with five different structural parameters were investigated, and the force mechanism was analyzed. We present nine CEA channels with different aspect ratios based on the process of changing the particle equilibrium positions. The results show that 10-15 μm particles have the potential to generate a side focusing line as the structural parameter (¬R□) increases. For a determined channel structure and target particles, when the Reynolds number (R_e) exceeds the critical value, the focusing pattern will transform from a single pattern to a double pattern. The parameter α/R□ can be used to calculate the critical Reynolds number for the focusing pattern transformation. The results can provide guidance for microchannel design and biomedical analysis.

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