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Compact and controlled microfluidic mixing and biological particle capture[1] MATTHEW BALLARD, DREW OWEN, ZACHARY GRANT MILLS, PETER J. HESKETH, ALEXANDER ALEXEEV, Georgia Institute of Technology — We use three-dimensional simulations and experiments to develop a multifunctional microfluidic device that performs rapid and controllable microfluidic mixing and specific particle capture. Our device uses a compact microfluidic channel decorated with magnetic features. A rotating magnetic field precisely controls individual magnetic microbeads orbiting around the features, enabling effective continuous-flow mixing of fluid streams over a compact mixing region. We use computer simulations to elucidate the underlying physical mechanisms that lead to effective mixing and compare them with experimental mixing results. We study the effect of various system parameters on microfluidic mixing to design an efficient micromixer. We also experimentally and numerically demonstrate that orbiting microbeads can effectively capture particles transported by the fluid, which has major implications in pre-concentration and detection of biological particles including various cells and bacteria, with applications in areas such as point-of-care diagnostics, biohazard detection, and food safety.

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