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Microfluidic multi-target sorting by magnetic repulsion

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Abstract: In magnetophoresis-based microfluidic systems, the free-flow sorting is achieved by incrementally navigating the magnetic target toward a designated outlet. This is typically enabled using high-gradient magnetic concentrators (HGMCs), axially aligned or slightly slanted with the streaming sample flow. Such axial and incremental magnetic manipulation critically constraints the throughput and the number of targets that can be sorted simultaneously. To overcome these constraints, we present an alternative repulsion-based sorting method. The repulsion force is due that induced, over a limited angular expanse, around a single ferromagnetic wire. The wire is positioned transversally against the focused sample flow. Differentially repelled by the repulsive force, each target deflects from its focused path to follow a ribbon-like trajectory that leads to a spatially addressable outlet. The mediated sorting takes place more rapidly and is confined to the region facing the transversal wire. More importantly, the introduced concept design allows for a throughput that is geometrically scalable with the length of the wire. The functionality of the systems is demonstrated experimentally and numerically to yield the simultaneous and complete multi-target sorting of two and more magnetic beads.