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Experimental and numerical investigations on the separation behavior of magnetic particles under an alternating gradient magnetic field

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Magnetic particles are known to align and aggregate into multi-particle clusters in an applied magnetic field, and this aggregation phenomenon has been widely used in various biological and chemical applications. However, it will give rise to the separation difficulty of multiple types of magnetic particles with different sizes in traditional magnetic separation process. In this work, an alternating gradient magnetic field is designed and applied to solve the aggregation problem between particles, which is based on the fact that the inter-particle interaction force changes with the external field direction. By varying the magnetic field direction periodically in the region of interest, intermittent repelling forces acting on the particles lead to the disaggregation of clusters for better separation. To validate the feasibility of this method, the aggregation and separation behavior of magnetic particles with different sizes (10μm, and 5μm) is numerically investigated, showing that the two types of particles could be separated effectively under the dynamic field, while they are easy to form a chain and move together under the static field. These results are corroborated by microscopic visualizations of magnetic particles in the experiments.

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