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A Method and System of Rotating Magnetically Inducible Particles

Magnetically inducible particles, such as paramagnetic microspheres, when placed in an external magnetic field align along the magnetic flux lines, to form aggregates in the form of long chains. This phenomenon has been the topic of interest in recent years due to its possible applications in microfluidics and rheology.

Until now the preferred method of magnetic field generation has been via the electromagnetic technique, in which Helmholtz coils placed across the fluid cell are used to generate an external field. At small distances, the field is uniform and unidirectional, and the flux lines pass through the fluid cell, all in the same direction from one end to the other.

Researchers at ASU, in a recent study, have used a strong rare-earth magnet to provide the external magnetic field. When placed over a fluid sample containing the magnetically inducible particles a unidirectional magnetic field is created in the fluid suspension and causes the microspheres to form chains. When the field is rotated, by revolving the magnet, the particle chains also rotate about their centers. This produces a micro-rotor mixing effect. This device is much simpler than the Helmholtz coil arrangement that requires function generators, power amplifiers and cooling systems for generating and rotating the magnetic field.

Potential Applications

- Liquid Mixing in DNA Sequencing Chips
- Medical Diagnostic Testing
- Microflow Cytometry
- Mass Spectroscopy
- Microfluidic Electrophoresis
- Lab-On-A-Chip
- Micro Cell Culture

Benefits and Advantages

- Increased mixing in micro and macro devices and reactors
- Non-turbulent mixing - Low Reynolds number
- Technology does not rely on a specialized chamber design - Mixing can be performed within any micro-well or micro-channel
- Compatible with cells and other shear sensitive components in solution - The micro-rotors impart very low levels of hydrodynamic shear stress
- Magnetic field external to the fluid sample
- Mobile - Can be located to any area of interest
- Magnets can be arranged to produce fields that are either uniform or non-

uniform

- Combination of magnet and motor arrangement can be used to produce particle rotation about various axes
- Increased effective heat and mass diffusivities in the local area around the particles