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Integrated magnetic manipulator and microfluidic sample chamber for parallel application of isotonic forces

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Integrated magnetic manipulator and microfluidic sample chamber for parallel application of isotonic forces.

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Abstract

Magnetic micromanipulation is used to perturb molecules and cells with uniform, position independent mechanical forces transmitted locally through magnetic beads. Position independent forces are useful for many types of assays and also for simultaneous parallel experiments. Magnetic fields are also easily used to apply torques.

Multipole electromagnets are useful for creating uniform forces in 3D since forces can be accurately controlled by the current in the coils. However, two common problems with this design are that long working distances are required and that the poles flex due to the strong fields within the manipulator. To overcome these limitations, we are using photolithography and electroforming techniques to fabricate poles of high magnetic saturation strength alloy directly in microscope coverslips. The poles transfer magnetic fields from external coils to the sample. A microfluidic sample chamber is fabricated between two of these coverslips, forming the manipulator. The distances are kept small enough such that oil immersion objectives can be used. Pole bending is minimized due to the rigidity the sample chamber lamination. Supported by UIUC Research Board and NIH PHS 5 P41 RRO3155.