High Performance Magnetic Separation Technology for Microtiter Plates, Microarrays, Single Molecule Manipulation and Beyond

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Introduction

Hybrid magnetic technology is in use in production and R&D molecular separation processes by the DOE Joint Genome Institute and is in continuing development at Lawrence Berkeley National Laboratory. Its fields of applicability range from genomics, proteomics and single molecule microscopy to bio-medical and general industrial processes. In addition to existing, production hybrid magnet plates for 384-well microtiter plate applications; new designs have been developed for 96-well, 384-well, 1536-well and deep well plates. These new, more advanced, second-generation magnet plates incorporate higher performance core structures that deliver higher fields and stronger gradients for faster drawdown and greater holding power for more robust processes. Field measurements of new prototypes have shown peak fields in excess of 11000 gauss. Development has proceeded on 1536-well magnetic structures that also have applicability for high-efficiency microarray processes.

A newer field of application for hybrid structures is single molecule magnetic manipulation or magnetic tweezers. This technology has significant advantages over laser capture/manipulation techniques and has the ability to cover a manipulation force range from zero to that of atomic force microscope levels. A number of successful prototypes have been built at LBNL and are now in use at various institutions.

In addition to established applications, hybrid magnetic technology shows promise in other areas such as bio-medical treatment techniques and industrial applications.

Applications

- Functional genomics
- Genetic sequencing
- Proteomics
- Immunological drug screening
- Automated DNA purification
- Automated protein purification
- Any magnetic bead based purification method
- Industrial flow separation techniques
- Single Molecule Manipulation

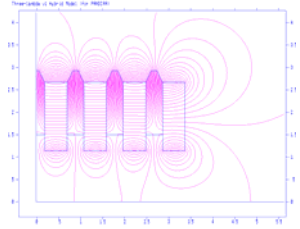
Target Species Are Magnetized

- Magnet plates work in conjunction with ~ 1 to 4 micron magnetic beads
- Beads are attached to DNA or other targets such as proteins by means of specialized bead coatings
- Various bead types are commercially available

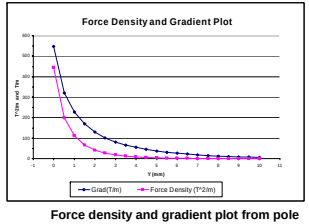
Unique Technology with Broad Applicability

- Hybrid technology has been applied to magnet plates developed at the DOE Joint Genome Institute and Lawrence Berkeley National Laboratory for high-throughput purification of biological samples in high-density microtiter plates
- Technology can selectively separate proteins, DNA and other molecules from various contaminates based solely on a magnetic field
- Magnetic structure is a unique hybrid of permanent magnet and ferromagnetic materials that produces magnetic fields significantly stronger than those of commercially available magnetic plates
- Hybrid magnetic structures are currently an enabling technology for sequencing more than 3 Gigabases of DNA per month at the JGI

Hybrid Magnet Plate and 384-Well Microtiter Plate



Cross-section of 384-well magnetic structure showing field distribution

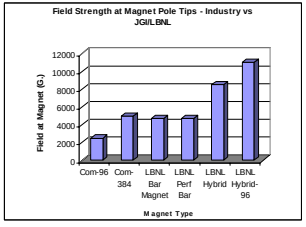


Force density and gradient plot from pole tip to 1 cm above

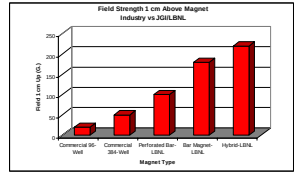
Biomek FX Liquid Handling Robot with Four 384-Well Hybrid Magnet Plates Installed

Advantages of Hybrid Technology for Microtiter Plate Applications

- Produces higher sample yields and faster processing times
- Fields are 70 to 100% stronger than that of the best commercial magnet plates measured
- Compatible with most 96, 384 and 1536-well standard microtiter plates
- Extended field range increases the usable sample and wash volumes
- Reduces labor costs and increases process reliability
- Validated in a high-throughput sequencing facility with 92+% of samples producing more than 630 Q-20 bases
- Hybrid magnet plates have been developed for general bench top use in addition to high throughput applications



Fields at magnet surface are 70% to 100% greater than industry 384-well magnet plates tested



Fields 1 cm above the magnet are more than 400% stronger than tested 384-well commercial magnets

Technology Transfer Opportunities

This technology is being patented by the University of California and is available for transfer to industry through the Technology Transfer Department of Lawrence Berkeley National Laboratory.

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