MAR08-2007-020053

Abstract for an Invited Paper
for the MAR08 Meeting of
the American Physical Society

Magnetic sifters and biochips for early diagnosis and therapy monitoring of cancer

CHRIS EARHART, Stanford University

Magnetic nanoparticles conjugated with biomolecules or recognition moieties are finding wide applications in medicine. In this context, we are developing a micromachined magnetic sifter and magnetic nanoparticles aimed for sample preparation applications in early diagnosis of cancer. The microfabricated sifter consisting of arrays of micron sized slits etched through a silicon wafer. A magnetic film is deposited on the wafer, producing high magnetic field gradients, comparable in magnitude to gradients in planar flow devices. As the solution flows through the die, magnetic particles are captured by the magnetic material surrounding the slits. The large number of slits allows for processing of large volumes of liquid, much greater than that of planar microfluidic devices. The sifters can be simply attached to a syringe or tube, resulting in a portable and user-friendly tool for molecular biology. Separation efficiencies of $\sim 50\%$ for one pass through the sifter have been achieved. We have also designed and fabricated several types of magnetic biochips consisting of arrays of giant magnetoresistive (GMR) spin valve detectors with appropriate dimensions, surface chemistry, and microfluidics. An advanced electronic test station has been set up as a demonstration vehicle for the integrated evaluation of our magnetic biochips with commercial and custom magnetic nanoparticle labels for DNA or protein biomarkers. The magnetic biochip is capable of detecting down to 1-30 nanotags. Real-time detection of DNA signatures and protein targets in buffer and serum samples has been successfully performed in our laboratories, suggesting that magnetic biochips hold great promises for molecular diagnostics of cancer and other diseases. In collaboration with Chris M. Earhart, Wei Hu, Robert J. Wilson, Sebastian J. Osterfeld, Robert L. White, Nader Pourmand, and Shan X. Wang @ Stanford University. This work was supported by grants from NIH (1U54CA119367-01) and DARPA/Navy (N00014-02-1-0807).