Construction of a Magnetic Biosensor for Pathogen Detection

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Current methods for pathogen detection require days before a result is available, while biosensors offer the advantage of quick, on the spot results. In this project we present the proof of concept of a biosensor that uses giant magnetoresistance (GMR) sensors and a microfluidic system. The bioprobe consists of a 30 bp oligonucleotide, 5′ functionalized with a thiol group (T-DNA30) immobilized on a gold surface. Hybridization was tested with a 5′-biotinylated oligonucleotide complementary to T-DNA30 to which Streptavidin-R-Phycoerythrin was attached later. The difference in fluorescence between the target sample and control samples was observed using a scanning laser confocal fluorescence microscope. The GMR device consists of an Ir0.8Mn0.2/Co0.9Fe0.1/Cu/Co0.9Fe0.1/Ni0.82Fe0.12 multilayer structure. Magnetic nanoparticles were deposited directly on the surface of the GMR sensors. An external magnetic field was employed to polarize the nanoparticles, which can then be detected by comparing the resistance change loops of the GMR sensors before and after their deposition. A transparent elastomer, polydimethylsiloxane (PDMS), was used for the microfluidic system. The system comprises two microfluidic channels separated by a 200 μm PDMS wall. The channel width is 200 μm and its height 100 μm. The PDMS channel was permanently bonded to the SiO_2 surface of the GMR sensor. The integrated biosensor will immobilize thiolated DNA on the gold surface below which the GMR device is located. For hybridization, biotinylated DNA will be used. Finally, magnetic nanoparticles, coated with streptavidin will be attached to the hybridized DNA and detected by the GMR device.

