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Miniature Multi-bit Magnetic Tags for High Throughput Biological Analysis

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Convergence between nanotechnology and biotechnology in the last decade has led to interest in the development of miniaturized high-throughput / high-contents screening (HTS, HCS) system for the detection of DNA, protein, cell, virus etc. Among the various emerging bioassay technologies, magnetic bioassays, which utilize the high resolution magnetic sensor for the detection of biomolecules, are now attracting much interest because of their unique advantages such as ultrahigh sensitivity, selectivity etc. In this study, we have investigated a new magnetic labelling technology for high-throughput biomolecular identification and DNA sequencing. Planar multi-bit magnetic tags comprising a magnetic barcode formed by an ensemble of micron-sized thin film ferromagnetic bars and a Au square for immobilization of probe molecules have been designed and fabricated. We show that by using a globally applied magnetic field and magneto-optical Kerr microscopy the magnetic elements in the multi-bit magnetic tags can be addressed individuallyand encoded/decoded remotely. The power of the approach is the read/write technique, which allows modest globally applied magnetic fields to write almost unlimited numbers of codes to populations of tags rather than individuals. The magnetic nature of the technology also lends itself naturally to fast, remote decoding and the ability to rewrite tags if needed. We demonstrate the critical steps needed to show the feasibility of this technology, including fabrication, remote writing and reading, and successful functionalization of the tags as verified by fluorescence detection. This approach is ideal for encoding information on tags in microfluidic flow or suspension, in order to label oligonucleotides during split-and-mix synthesis, and for combinatorial library-based high-throughput multiplexed bioassays.

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