

Spintronics Devices for Bio-medical Applications

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The manipulation and monitoring of cells has gaining more important towards gene sequencing, single cell analysis and cell separation technology. Although, several single cell techniques are exist, there is still challenging and complex to collect rare cells and their digital manipulation in large-scale operation. Recently, the flexibility of magnetic transport technology using nano/micro scale magnets for the magnetophoresis has experienced excellent advances and has been used for a wide variety of single cells manipulation tasks. The magnetic transport technology, which can be integrated within microfluidic channels, relies on both magnetic energy and force tunability and remote control implemented by micro- and nano-patterned magnetic structures. Here, we have demonstrated a class of integrated magnetic track circuits for executing sequential and parallel, timed operations on an ensemble of single particles and cells. The magnetic circuitry tracks are designed by conventional lift-off technology and were used for the passive control of cells/particles similar concept to electrical conductor, diodes and capacitor. When the magnetic tracks are combined into arrays and driven by rotating magnetic field, the single cells are precisely control for multiplexed analysis. The concentric cell transportation and separation were performed by the assembly of this magnetic track into a novel architecture, resembled with spider web network consisted of several radii and spirals, where all the particles/cells are concentrated into one position and then transported to apartments array for the single cell analysis (Fig. 1). In addition, a planar Hall resistance (PHR) sensor is integrated with the web networks, and the manipulation and detection are achieved via superparamagnetic particles with dual functions as a biomolecule carrier for transportation and labels for monitoring (Fig. 2). This allows the efficient collection of low-density biomolecule carriers to one specific point and monitors the accumulated carriers.

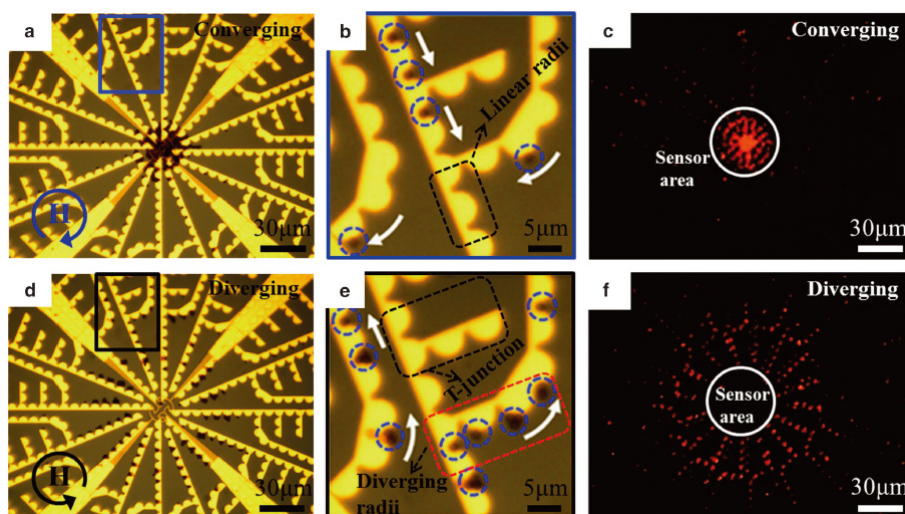


Fig. 1. Collection of bio-agents using the magnetic spider web.

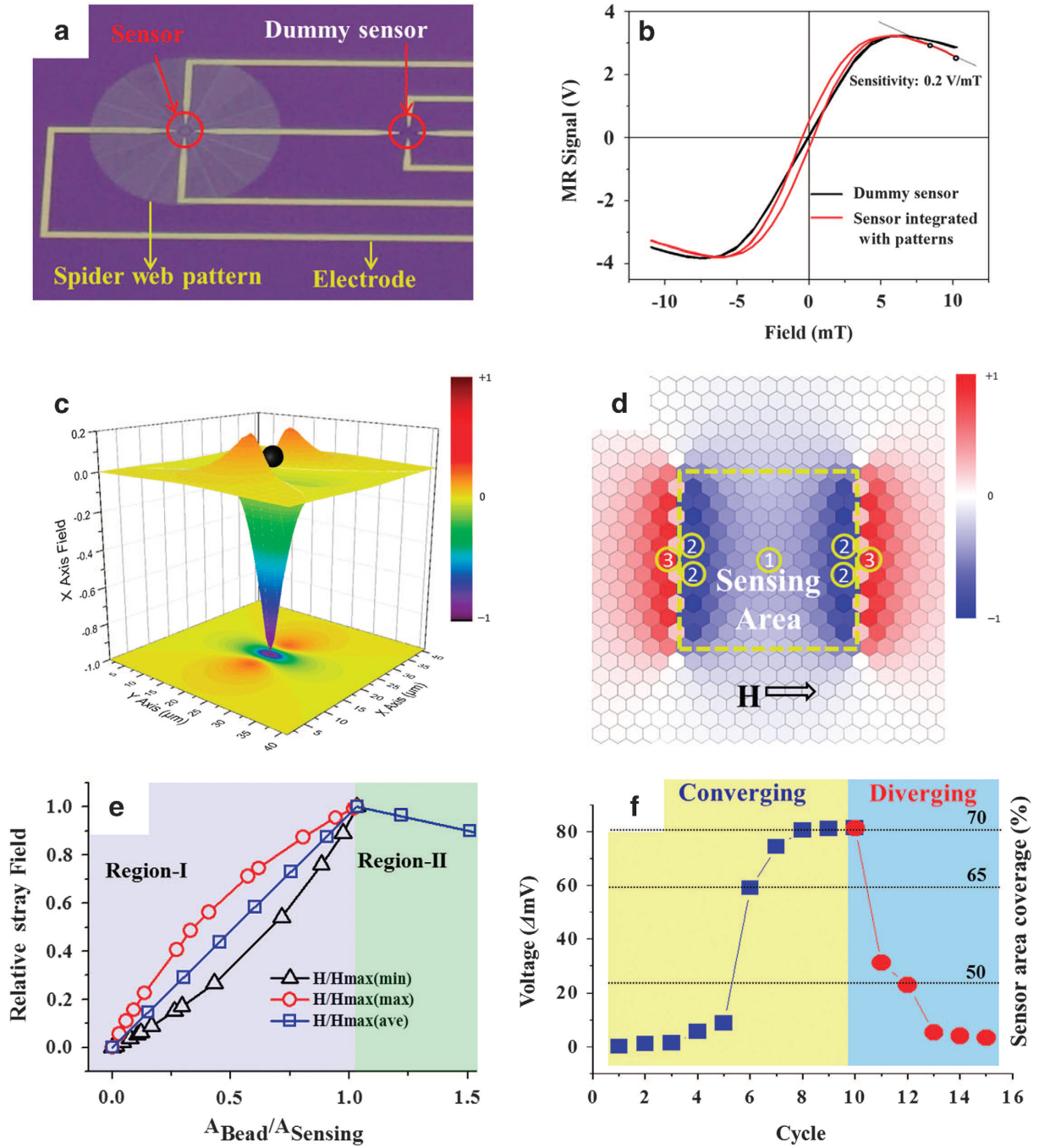


Fig. 2. Simultaneous manipulation and monitoring of bio-functionalized superpara-magnetic particles.