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MICROSYSTEM FOR THE IMMUNOMAGNETIC DETECTION OF ESCHERICHIA COLI O157:H7

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A hand held microsystem has been designed for the immunomagnetic detection and quantification of the pathogen *Escherichia Coli O157:H7* in food and clinical samples (Fig. 1). The followed main aims have been the design of the microfluidic circuitry, the sensing film and the packaging needed to carry out the assays in a safe and straightforward way. This work describes a technology that facilitates the integration of 3D microfluidic networks with any microfabricated biosensor to manufacture a Lab on a Chip.

The sensor layout is a redundant measuring system which consists on two pairs of microfluidic channels, where four different magnetoresistances per channel have been placed. Two different microfluidic network designs have been analysed: one, with one inlet and one outlet, and the other one, with two inlets and two outlets (see Fig. 2). The first one, allows a more redundant measurement, but no reference is available to discriminate between the signal and the noise. On the other hand, the second Y shaped design allows the use of a reference channel, and assures that the same flow of sample goes through all channels. This equal flow rate is necessary in order to get a reliable sensor measurement. Flow rate tests have been performed inserting a blue dyed liquid with a syringe at a constant pressure of 0.5bar. Figure 3 shows the liquid advances at the same rate in all channels without leaks.

The structural material used for the development of the microfluidic channels is the epoxy negative photoresist SU8, which has been chosen because of its excellent electrical, mechanical and fluidic properties, and its biocompability [1]. The fabrication process is based on successive photolithographic and bonding of SU8 layers at low temperature [2]. This process allows the fabrication of a 3D microfluidic network, with perfectly sealed channels and reservoirs with heights up to 180μm.

The biosensor must be capable to detect and quantify small magnetic field variations caused by the presence of superparamagnetic beads bound to a biological species previously immobilised on the sensor surface via an antibody-antigen reaction. Therefore, a copper-permalloy multilayered structure [3] has been chosen as sensing layer, which reports a highly sensitive magnetic response at low magnetic fields (Fig. 4). Figure 5 shows the fabrication process of the sensing thin film.

As a packaging prototype a plastic capsule with external flexible tubes and an o-ring per reservoir has been fabricated by means of stereolithography. All the pieces are aligned and pressed together by screws, allowing an easy replacement of the tested chip (Fig.6). The package allows the user to insert the sample by a simple syringe (Fig. 7).

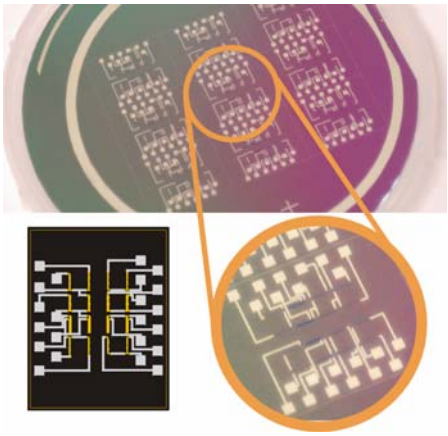

Figure 1. Microfluidic channels and sensors design

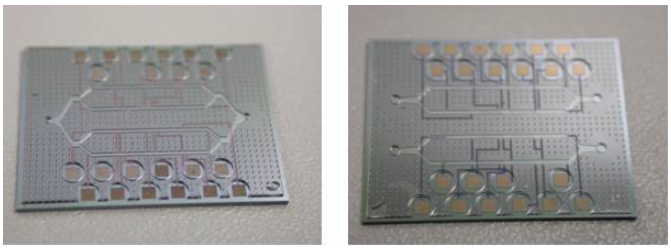

Figure 2. Microfluidic networks with 1 inlet/outlet (left) and 2 inlets/outlets(right).

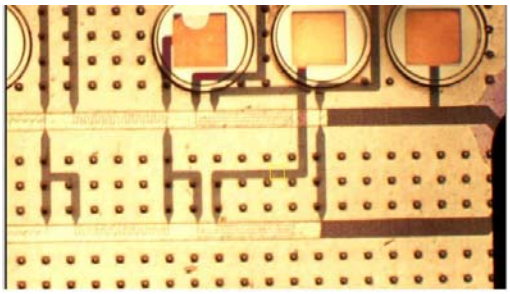

Figure 3. Microfluidic test with blue dyed liquid

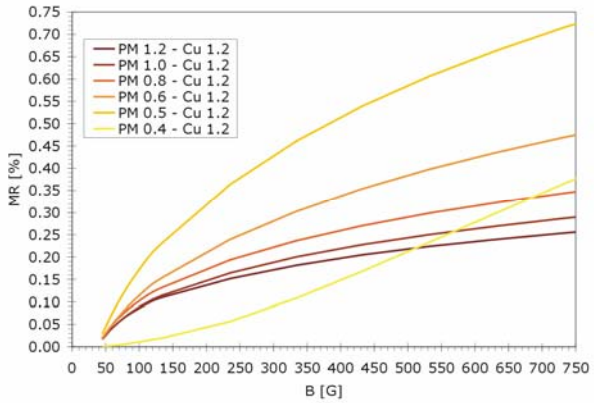

Figure 4. Magnetic response of different multilayer structures.

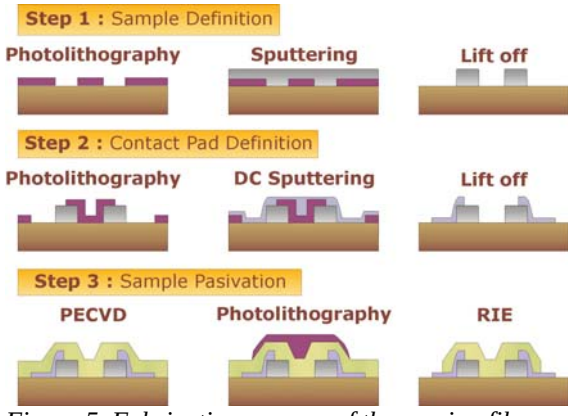

Figure 5. Fabrication process of the sensing film

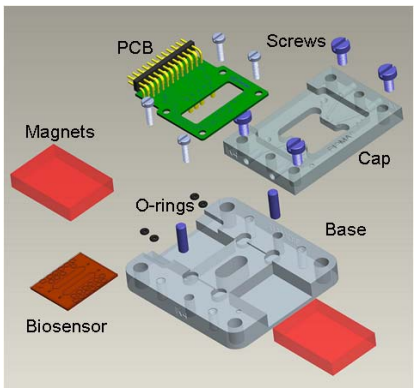

Figure6. 3D schematic of device packaging design.

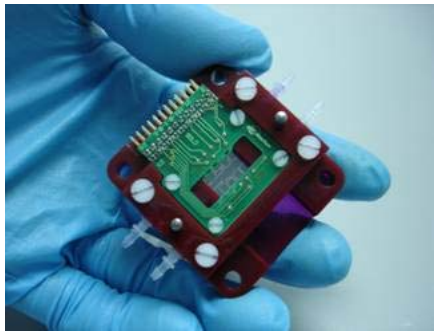

Figure7. Packaged microsystem.

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3. "Comparison of a prototype magnetoresistive biosensor to standard fluorescent DNA detection," J. Schotter, P.B. Kamp, A. Becker, A. Pühler, G. Reiss, H. Brückl, Biosensors and Bioelectronics 19, 1149-1156 (2004).