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Preselection of Cancer Cells using a microfabricated microfluidic Cell Sorter

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Introduction

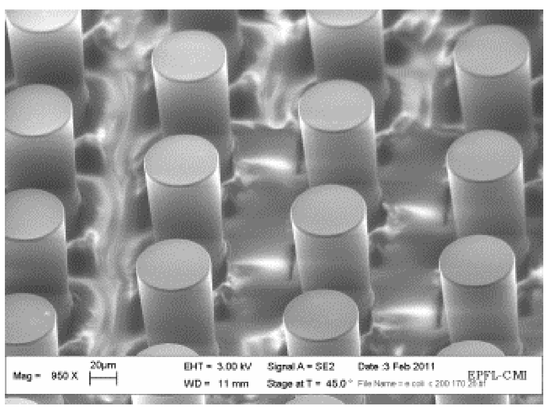

Fig. 1. Section of a microfluidic dielectrophoretic cell separation chip. The 3-D carbon electrodes are shown. The electrodes are capable of trapping the cells

Within PATLiSci early diagnostics tools based on microfabricated cantilever sensors are developed for the detection of cancer markers (see poster ***Personalized medical Diagnostics based on Nanomechanics***) e.g. from melanoma or head and neck cancer. Two different approaches are developed: (i) The examination of cancer cells through the analysis of tumor specific markers in enriched samples or by direct trapping of cancer cells and further analysis of their mechanical properties or responses to drug treatment (see poster ***Cantilever array sensing of tumor cells***). (ii) The detection of volatile organic compounds (VOC) present in the exhaled breath of patients suffering from head and neck cancer (see poster ***Nanomechanical membrane surface stress sensors for medical breath testing***) or collected from small cell cultures. Preselection and enrichment rely on specific devices (**Fig. 1**) which should be easy to handle and manufacture but also small enough to be integrated within the microcantilever analysis devices. With P. Renaud and his group at EPFL we have excellent help and expertise in building microfluidic systems (see poster ***Microfluidic tools for novel cell applications***) suitable for the goals mentioned above.

Microfluidic Cell Sorter and Bioreactor

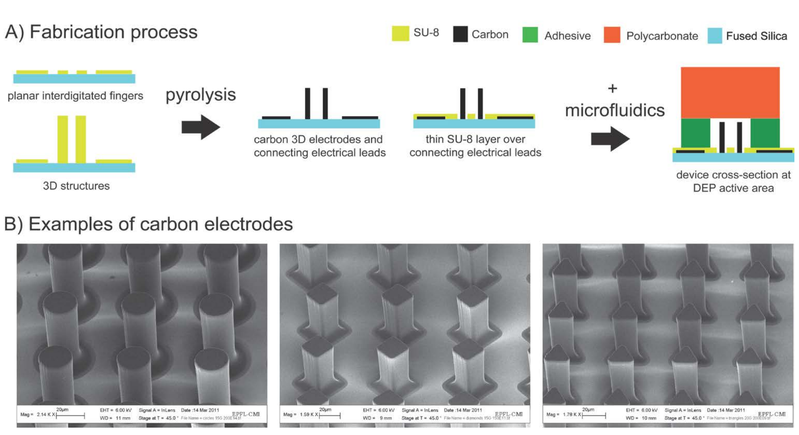

Fig. 2. A) The manufacturing process and **B)** some examples of 3-D dielectrophoretic carbon electrodes are depicted.

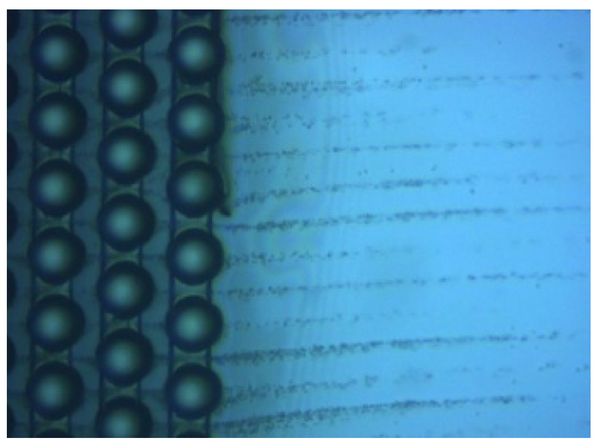

Fig. 3. Micrograph evidencing that cells can be released after trapping when electrodes are switched off. Dotted lines highlight rows of cells flowing from the chip.

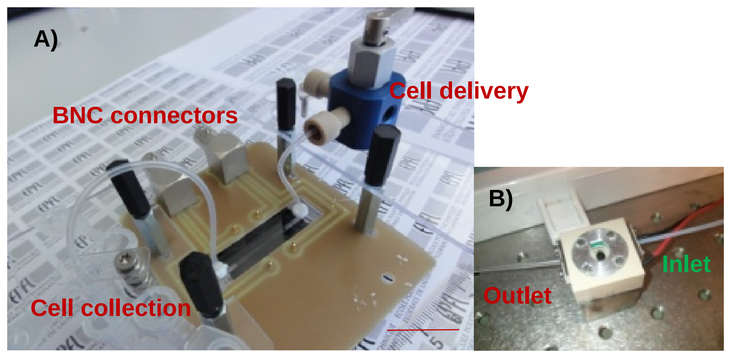

Fig. 4. A) The dielectrophoretic chip (in black in the centre) mounted in the electronic setup and attached to in- and outlet tubing for cell delivery and collection. **B)** For comparison the fluidic chamber of the microcantilever device is shown. Scale bar 2.5 cm.

The cell sorter (**Fig. 2**) is able to trap cells dependent on their dielectrophoretic properties (**Fig. 3**). One example would be to trap specifically cancer cells from biopsies or in a more advanced setup to separate and enrich circulating tumor cells (CTCs) and then release them from the chip for further analysis with microcantilevers. The microfluidic system can be easily attached to microcantilever devices requiring no further connections than a single tubing (**Fig. 4**). The same principle can be applied to trap cancer cells in a microfluidic bioreactor (**Fig. 5**) for cultivation and analysis of the VOCs they produce.

Fig. 5. Schematic representation of a microfluidic bioreactor for trapping cancer cells. We could analyze the VOCs produced by them directly. It is possible to then compare the bending patterns of VOCs produced by the cells to patterns produced by healthy or diseased patients. This is facilitated by the use of PDMS in the microbioreactor design, because PDMS is gas permeable and thereby samples can be collected easily without disturbing the microfluidic chip.