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APPARATUS FOR ULTRA-LOW VOLUME FLUID SENSING

Researchers at the University of Cambridge's Department of Chemistry have developed a novel apparatus that will enable label-free sensing to be applied to fluids with volumes as low as 0.25 µl. The apparatus is designed to be used with MEMS sensors such as microcantilevers, but could easily be adapted to other forms of sensor such as surface plasmon resonance or quartz crystal sensing. The new apparatus should facilitate detection in a wide-range of areas including proteomics, genomics, healthcare diagnostics, environmental monitoring and manufacturing quality at sample volumes much smaller than are currently available with competing technologies. The microcantilever sensor chips can be readily multiplexed.

This technology offers the following advantages over competing systems:

- low sample volume
- applicable to gas and liquid phase sensing
- no dead volume or risk of sample cross-contamination
- adaptable to sequential, simultaneous or independent sampling
- fast, simple and reproducible sensor-chip mounting
- stress-free and reusable sensor mount
- robust with few components
- easy integration with Phase-Shifting Interferometric Microscopy (PSIM) enables simultaneous reading of multiple microcantilever arrays

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Background

Microcantilever MEMS technology is finding increasing use in the field of sensing; whether this be for environmental monitoring, medical diagnosis or biological research, the ability to carry out label free-detection is highly valuable. However, cells currently available for containing the sensor chips have several drawbacks. Alignment of the chip is often difficult and time consuming, the sample volume required is unnecessarily high and the clamping mechanism can be overly complicated. These technologies also fail to accommodate the need for cells that can contain multiple chips and address these sequentially, simultaneously or independently.

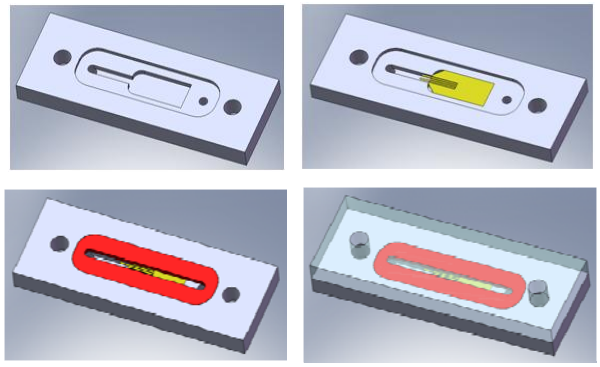

Figure 1: The assembly of the base, chip, seal and lid for a single chip system

New Technology

This technology features a cell design that consists of only three components plus the sensor chip (see Figure 1 above). This novel design is beneficial as the external clamping minimises the dead volume of the cell and reduces the risk of contamination. Prototypes require only 0.25 µl of fluid to work. Moreover, the alignment of the sensor cell is automatically achieved from fitting it to the base. The chip can be easily removed from the cell and replaced, allowing the apparatus to be re-usable.

The technology may be adapted for use with multiple sensor chips. Figures 2 and 3 depicts four chips, each with 2 microcantilevers, arranged to detect the content of one fluid sample.

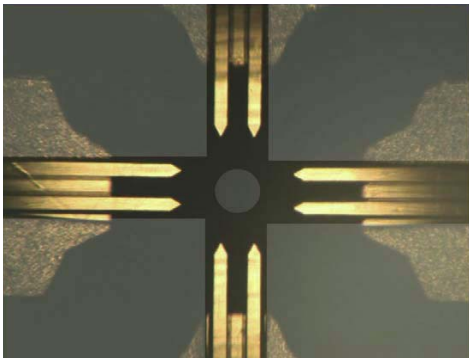

Figure 2: A multi-chip system design

Testing has shown that, while the cantilevers may be addressed in several ways, Phase-Shifting Interferometric Microscopy (PSIM) can be easily used to read multiple chips with one light source. The chips can be read either individually or simultaneously.

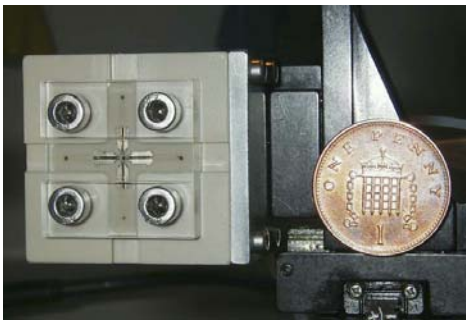

Figure 3: A prototype device

The unique properties of this system give clear, practical advantages over currently existing techniques, but also open the possibility of using these sensors where a very limited amount of fluid or gas is available, such as in medical diagnosis or quality testing of high-value products.

Commercialisation

We are seeking commercial partners for licensing, collaboration and development of this technology. This technology is protected by UK patent application number GB0910569.3 (filed 18 June 2009).