SENSE & FIBRELITY: NEXT GENERATION OPTICAL BIOSENSORS

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Abstract Biosensors now play a vital and essential role in medicine, industry and the environment, providing routine analysis, crucial monitoring, and early detection of problems and crisis points. Biosensors are increasingly finding applications in homeland security, as well as in bio/pharmaceutical research. The market for biosensors is forecast to swell to £5.7 billion in 2007, with an annual growth rate of around 10 per cent [1], as new techniques address the issues of accuracy, response time, ease of use and cost, which currently determine specific implementation in different sectors.

Solutions based on integrated optics -- lab-on-chip and microfluidics -- are now gaining an increasing foothold on the biosensor market.

Technology In the Optoelectronics Research Centre we have recently developed and patented an impressive 'squeezed fibre'. We have developed this remarkable fibre using expertise that combines the advantages of fibre technology and integrated optical devices. The advantage of using established fibre manufacturing techniques makes this next-generation technology a low cost solution. The benefits of using the squeezed fibre for optical devices over a standard optical fibre and conventional planar substrates are highlighted in Figure 1.

Recent results Functional optical components such as power splitters and wavelength filters/reflectors (gratings) have been demonstrated using a combination of the squeezed fibre and direct laser writing. Such components have been of substantial benefit to the telecommunications and sensing industries. Simultaneous tests on different bio/chemical agents and the subsequent analysis on the same chip are made possible by having multiple functionalities over long sample lengths. Crucial developments in integrated light sources/detectors and the incorporation of secondary inspection gratings will further increase the surface functionality of these chips, allowing for highly accurate, real-time self diagnostics over a remarkable variation of stimuli and geographical area.

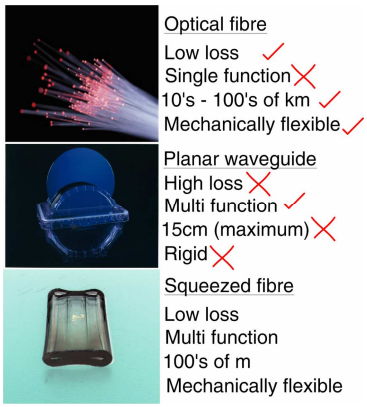

Figure 1 Comparison between optical fibre, planar waveguide and squeezed fibre

Future work We are currently developing the technology further for sensing applications by incorporating capillary tubes for micro-fluidics. Designing a mechanically flexible, long-length, integrated chemical/biological sensor is also underway with applications in homeland security, manufacturing, and environmental pollution. Such concept is depicted in Figure 2 with resolution/sensitivity of up to 10^{-6}.

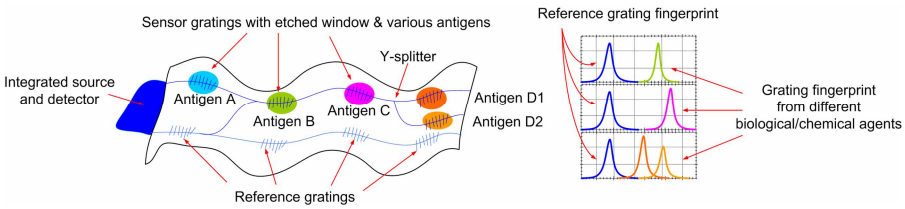

Figure 2 Fully integrated extended length flexi-sensor for bio/chemical sensing

Acknowledgments: Various sponsors contributed to this work including EPSRC, DTI, CASE, Ministry of Science, Technology and Innovation, Government of Malaysia and University of Malaya (Malaysia). Inputs from Rachel Abbott, Robert Simpson and Joyce Lewis are also acknowledged.

[1] Biosensor Market, R&D and Commercial Implication www.fuji-keizai.com/e/report/ biosensor2004_e.html < 28th September 06>