Progress in Biomedical Optical Sensing

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Optical sensing for biomedical applications continues to advance. Integrated and integrable device structures based on classical planar fabrication technologies are a key aspect of the development of low-cost and reliable sensors at both the molecular and cell levels. Resonant structures based on both photonic crystal and metamaterial/plasmonics concepts are of continuing interest, while cavities in the form of waveguide ring resonators are also competitive. Closely related waveguide Mach-Zehnder structures can also provide the sensitivity required for successful application.

Fluorescent labelling has been demonstrated as a viable approach in biomedical sensing, e.g. for carrying out competition immunoassays to identify the possible presence of specific analyte molecules in suitably prepared fluid samples, via antibody-antigen type reactions, with antibodies bound to the surface of a sample substrate. But the alternative of label-free biomedical sensing seems likely to be the favoured approach for near-future application.

Tuning of reflection, transmission or even absorption resonances can help in the identification process for specific molecules, via selection of known bond resonances of the molecule or molecules of interest. Since it is typically possible to organise resonant structures in arrays that consist of thousands of individual resonant ‘atoms’, thereby forming what is sometimes called a metasurface, it becomes possible to select and quantify several characteristic molecular bond resonances - and thereby identify possible bio-molecular compositions. Structured surfaces such as photonic crystal waveguide slabs can provide valuable signal increases in optical microscopy, e.g. in photonic crystal-enhanced microscopy (PCEM).

This presentation will provide an overview of recent progress in the domain of bio-medical sensing.