

# Planar Lightwave Platforms for Bio- And Chemical Sensing

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Simple planar waveguides are well established components for the optical interrogation of chemical processes at surfaces, with total internal reflection fluorescence (TIRF) elements having a long pedigree and surface plasmon resonance (SPR) sensors finding widespread use in biomolecular research, for example. Key attributes of these devices are that the optical fields are confined to a submicrometer region above the solid surface of the transducer and that the light is delivered to the surface in a well-controlled way without passing through the bulk of the sample.

Integrated optics aims to exploit the technological approaches of microelectronics and guided-wave optics to realise optical waveguide circuits on a chip, with application to telecommunications being the driving force. A few integrated optical devices have seen great success in telecommunications systems and this has led to a sophisticated "toolkit" of integrated components for building planar lightwave circuits (PLC's). The use of the mass-production techniques developed for microelectronics brings low cost, and the micron-scale replication technology allows miniaturisation and dense integration. Planar lightwave circuits are realised by combining of photolithographic patterning and etching with the deposition of dielectric films onto surfaces or the diffusion of dopants into surfaces; and are thus inherently surface-sensitive devices. This property, which can be a hindrance for telecommunications devices, make PLC's particularly well suited to mass-produced bio/chemical sensor arrays, building upon the TIRF and SPR approaches mentioned above.

Integrated optical waveguides provide a strong and well-controlled evanescent interaction of light with chemical species at a surface over a long interaction length and in a very small sample volume, allow integration of reference sensors and arrays of sensors measuring different parameters on the same chip, can integrate metallic or transparent electrodes for electrochemical monitoring or reaction control, may probe a wide range of optical phenomena, and are compatible with microfluidics systems for sample delivery and with optical fibre for "solid-state" connection to instrumentation.

In this paper, the potential for planar lightwave circuits as versatile platforms for constructing advanced biosensors and chemical sensors by application of suitable surface chemistry will be discussed.