Lateral groove geometry for planar UV written evanescent devices - new flexibility, new devices.

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Conventional evanescent optical devices have made use of etched windows to allow access of an optical field to a material of interest. Such devices are a route to accurate refractive index sensors and to realising modulators, however, the geometry of etching the cladding to give the fluid access to a pre-defined core waveguide mode is limiting. In this work, we present an alternative approach in which a groove is cut using a polishing saw blade to give a vertical, high optical quality trench. Optical waveguides are then UV written to allow evanescent lateral access of the mode to a fluid placed in the trench. This seemingly subtle change in geometry provides greatly increased flexibility to tailor the interaction between the optical mode and the surrounding material, by, for example, changing the mode size and the allowing couplers or tapers to be used.

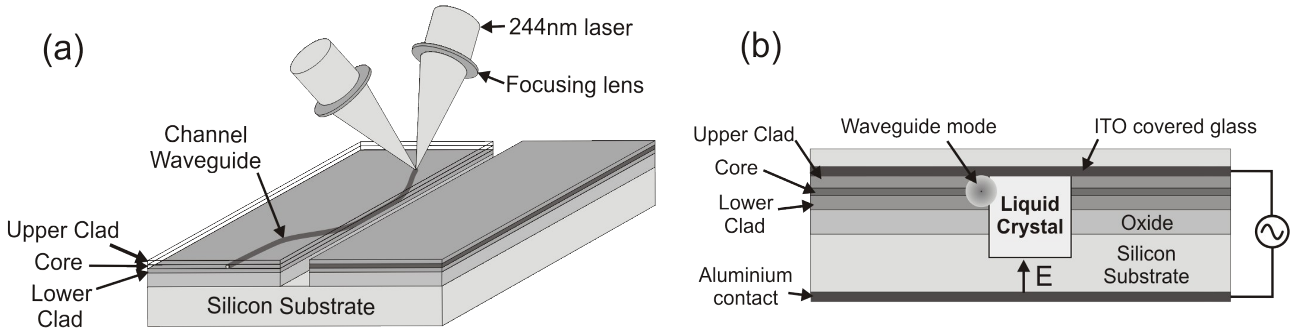

Fig. 1 (a) Shows UV writing of a lateral groove evanescent device. (b) Cross-section of a lateral geometry LC modulator.

Using a two-beam interferometer as shown in Figure 1 (a) it is possible to define a Bragg grating in the same process as writing the channel waveguide. Placing a grating in proximity to an etched or machined trench provides a direct method of measuring the perturbation of an optical mode. Interrogation of the modal index and hence the optical properties of the surrounding material is achieved via the reflected spectra from the Bragg grating.

Here we introduce a new geometry which embraces the benefits of planar technology to realise new integrated devices. The geometry allows several different devices to be defined on the same substrate. These may differ in modal size, Bragg wavelength, position of the waveguide relative to the trench and in the inclusion of temperature compensation gratings. We shall outline the inherent fabrication advantages and device feature benefits, these include a reduction in return loss, reduced spectral artefacts and a suggested reduction in stress induced birefringence.

Work within our group has largely concentrated on the application of refractive index sensors, targeted for use as biological and chemical sensing. Recently we have shown that such substrates may also be used to produce an electrically tunable Bragg grating by using a nematic liquid crystal. Using the conventional configuration, first demonstrated by Sparrow et al.[1], we have shown a modulation bandwidth of over 100 GHz. However due to the electrode configuration, hysteresis and an unstable temporal response has been observed. We shall present some improved results using the new geometry to fabricate a tunable liquid crystal Bragg filter. The change in geometry simplifies the fabrication of the device. We shall also discuss some future device concepts, combining modulators and sensors on to a single substrate. With a marked reduction in complexity and cost, this configuration may have significant impact in future integrated optical devices.

References

1. I. J. G. Sparrow, G. D. Emmerson, P. G. R. Smith, M. Kaczmarek, and A. Dyadyusha, "35 GHz tunable planar Bragg grating using nematic liquid crystal overlay," ECIO, Munich, Germany, 2005.