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A new hybrid fibre / planar platform for optics, offering ultralow loss and robust integration

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A novel hybrid optical fibre / planar platform is presented. The approach offers exceptionally low losses <0.003 db/cm and physical robustness. The approach is based on a combination of flame hydrolysis deposition onto an existing bare fibre laid upon a silica-on-silicon type substrate. Example devices include an anemometer and a narrow line laser based on external Bragg gratings.

This invited talk describes the development of a new concept in integrated optics that combines many of the advantages of optical fibres (eg low losses, and fusion splicing) with the stability and integrated aspects of conventional integrated optics. The new approach combines a well-established technology (flame hydrolysis deposition) with conventional optical fibres. The resulting devices, with optical waveguides permanently bonded to a silica-on-silicon substrate offer potential for many applications.

The new technique involves placing an existing optical fibre onto an oxidised silicon wafer, and then depositing oxide glass soot (silica doped with boron, germanium and phosphorous), to provide a glass that is chemical similar to the optical fibre itself. Upon sintering the fibre becomes permanently welded to the surface using the miscible optical grade glass.

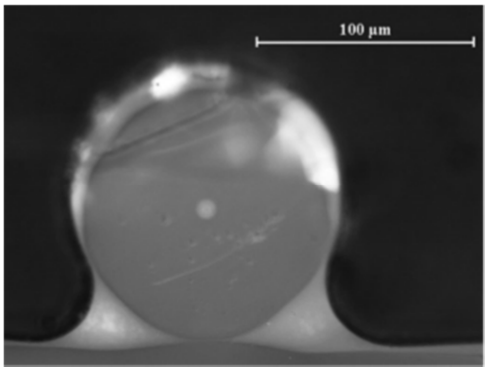

Fig. 8. Showing SEM image of hybrid planar fiber in end-on view. Note that the core of the single mode fiber is visible.

The resulting structures are extremely robust, and capable of further processing including the addition of Bragg gratings by laser UV writing, are robust enough to allow high quality polishing, and additionally can make use of physical processing steps such as machining and dicing to create novel structures..

This talk will review the basic concepts, provide data on the measured losses. In this regard the novel fibre offers potential for much lower losses than conventional

integrated optics. This is because fibre losses can routinely be below 0.2dB/km whereas planar waveguide losses are usually of order 0.1dB/cm suggesting up to 10^5 possible loss reduction. Measurements using Bragg gratings suggest that losses are <0.003dB/cm for our new devices.

To date, applications of the new approach have included the realization of an anemometer [1], and the use of the hybrid system in the realization of an external Bragg cavity semiconductor laser [2]. All the devices to date have been simple linear configurations, and suggestion as to how to extend to more complex structures will be presented.

References

[1] Christopher Holmes, James C. Gates, and Peter G. R. Smith, "Planarised optical fiber composite using flame hydrolysis deposition demonstrating an integrated FBG anemometer," Opt. Express 22, 32150-32157 (2014)

[2] Stephen G. Lynch, Christopher Holmes, Sam A. Berry, James C. Gates, Alexander Jantzen, Teresa I. Ferreiro, and Peter G. R. Smith, "External cavity diode laser based upon an FBG in an integrated optical fiber platform," Opt. Express **24**, 8391-8398 (2016)