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Thanks! Cori

All-UV-written integrated planar Bragg gratings and channel waveguides with no phase mask

G. D. Emmerson, C. B. E. Gawith, S. P. Watts, R. B. Williams, and P. G. R. Smith
Optoelectronics Research Centre, University of Southampon, SO17 1BJ, UK, gde@orc.soton.ac.uk

S. G. McMeekin, J. R. Bonar, and R. I. Laming
Alcatel Optronics UK, Starlaw Park, Livingston, EH54 8SF, UK

Direct UV writing provides an attractive route towards low-cost integrated optical components in photosensitive silica-on-silicon wafers. Combining closely packed channel waveguides with a Bragg grating tailored spectral response would allow the creation of compact systems for wavelength division multiplexing on a single optical chip. To this end, we present our new technique for simultaneous definition of channel waveguides with integral Bragg gratings based on the interference of two focussed UV-writing beams. This single-step approach promotes optimal use of sample photosensitivity for both the waveguide geometry and Bragg grating structure and allows implementation of many aspects of advanced grating design, such as chirp and apodisation, with no need for a phase mask.

In our UV writing arrangement two focussed beams are overlapped to give a micron-order near-circular spot with an inherent interference pattern in one dimension (Figure 1). Exposure of this intensity pattern onto a suitable photosensitive sample results in a periodic change in refractive index that can be extended, plane by plane, into a long grating in the simultaneously defined channel by on/off modulation of the writing beam during sample translation. When the sample is translated under a constant writing beam, the intra-spot interference pattern is averaged out and the focussed spot can be used to write standard channel waveguide structures, including curves and junctions. The combination of these two techniques allows planar Bragg gratings to be inserted into complex UV-written devices in a single processing step.

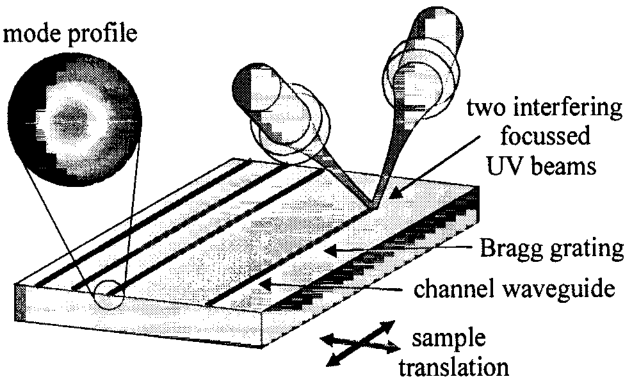

Fig.1. Simultaneous definition of channel waveguides and Bragg gratings by direct-UV-writing. A typical mode profile (4μm $1/e^2$ diameter at 633nm) is inserted.

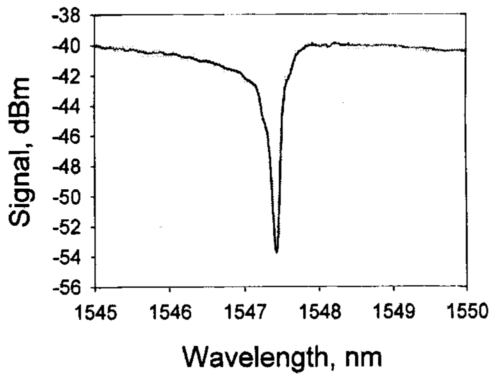

Fig.2. Typical spectral response for a channel waveguide with a 10mm-long integral Bragg grating.

Photosensitivity of the 3-layer germanosilica-on-silicon substrates used during this experiment was enhanced by deuterium loading. Direct UV writing was performed using a frequency-doubled 244nm argon-ion laser, a high precision 3-dimensional translation stage, and an interferometrically-controlled acousto-optic modulator. A beam splitter was used to create two separate beam paths at an intersection angle of 27 degrees, and both beams were individually focussed and aligned to give a single 3μm interfering spot.

With the absolute period of the interference pattern defined by the refractive index of the host material and intersection angle of the two focussed beams, the process of center-wavelength detuning [1] was applied to allow gratings with reflection peaks across the entire 1530-1580nm range of our ASE source to be created with no alteration to our setup. A range of planar gratings based on variations of period, length, and UV-writing conditions were written and subsequently characterised using an optical spectrum analyser. A typical spectral response from a channel waveguide with a 10mm long integral Bragg grating section is presented in Figure 2, demonstrating an unoptimised unapodised reflection peak of 98% with less than 0.3nm bandwidth. Based on these early results, it is hoped that optimisation of channel waveguide and Bragg grating characteristics will provide increased flexibility for the integration of complex grating structures into larger device geometries.

[1] M. Ibsen, M. K. Durkin, M. J. Cole, and R. I. Laming, *IEEE Photon. Tech. Lett.*, **10**, 842 (1998).