Direct UV writing for channel definition on FHD Silica-on-Silicon

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Abstract:
Direct UV Writing (DUW) is a relatively new technique used to define channels on photosensitive planar substrates and relies on a photosensitive reaction of the substrate material to UV light irradiation. Photosensitivity refers to the permanent (but reversible) change in the index of refraction of the waveguide core when exposed to light with characteristic wavelength and intensity that depends on the core material. A laser with an emission around the 240nm absorption window is focussed down to a circular spot about 4μm in diameter and the sample is then translated relative to this writing spot, with the path of translation defining the channel waveguide structure. The more advanced Direct Grating Writing (DGW) technique involves utilising interference pattern generated by crossed UV beams and allows the simultaneous definition of channel waveguides and grating structures. The UV interference pattern is generated by intersecting two tightly focussed coherent UV beams at a fixed point in space. A photosensitive sample is then aligned with this interference spot and translated relative to it. Both of the techniques require no clean room facility and involve no etching processes.

UV writing is particularly attractive for researching crossed waveguides as it is does not require etching and allows a smooth and continuous merging and splitting of channels.

Characterisation of direct UV written straight channels, s-bends and crossed waveguides are presented in this manuscript. The structures were defined on 3-layer photosensitive silica-on-silicon (SiO_2:Si) samples fabricated via flame hydrolysis deposition (FHD), involving the production of silica soot through the injection of halide reagents into a hydrogen/oxygen (H_2/O_2) flame. Straight channels written at various fluences show a saturation effect, possibly due to the sample reaching its upper limit of photosensitivity level whereas the s-bends display the reduction in excess loss with increase of bend radius as expected.