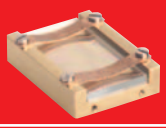
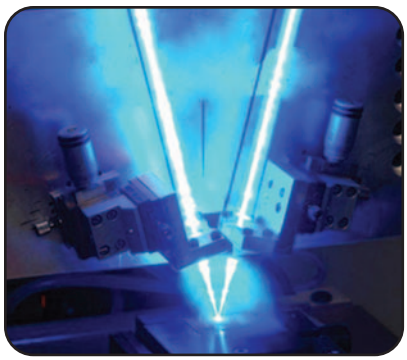


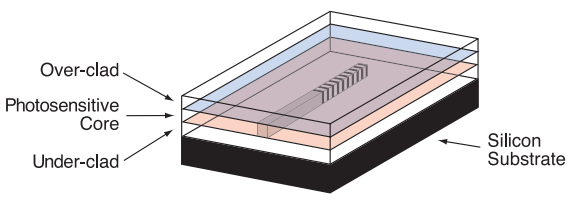




# UV Written Bragg Grating Waveguides – Tutorial – Stratophase



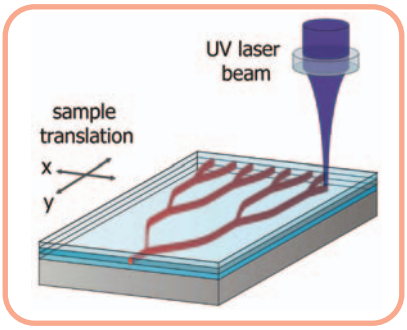
UV writing is a new technique that enables fabrication of low cost integrated optical circuits incorporating versatile Bragg gratings. These circuits enable new functions and facilitate new applications of integrated optics. They can also be used to replace "fiber spaghetti". The UV writing technique enables individually designed optical circuits to be written simply by programming the shape of the circuit into the computer control system. There is no need for costly photolithography and etching processes, and therefore the technique is ideal for production of small numbers of custom waveguide circuits. In addition to simply writing waveguide circuits, the patented Direct Grating Writing (DGW) technique enables sophisticated Bragg gratings to be incorporated into the waveguide circuits as the circuits are written. These Bragg gratings add functionality by providing filters, reflectors, dispersion compensation etc.




## Technology

Direct Grating Writing is a new technique developed by the University of Southampton and Stratophase Ltd. The technique works by using the fact that when Germanium doped silica is exposed to intense UV light, its refractive index increases. This is the same photosensitive response that is used to create fiber Bragg gratings in standard Germanium doped silica optical fiber. The Direct Grating Writing process uses industry standard silica-on-silicon substrates, and so the component reliability is assured. The platform is based on silicon wafers overclad with three layers of doped silica. The middle layer is Germanium doped and forms the core of the waveguide when it is exposed to UV laser light.

The germanium doped core layer is photosensitive, so that when exposed to a 244nm laser beam the refractive index increases to form a waveguide. Therefore, by focusing the laser beam to a spot and translating the sample under the focused spot, a waveguide circuit can be written – this is a process called UV writing.

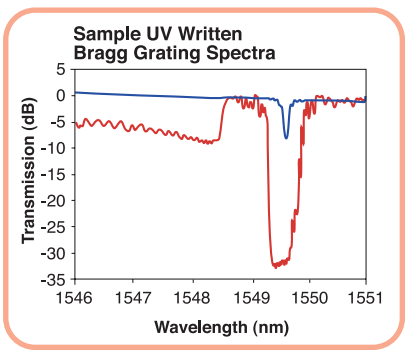



The direct grating writing technique is an improved version of the UV writing process that not only allows waveguides to be written, but also allows very sophisticated Bragg gratings to be written at the same time. This works by using two UV laser beams at an angle to each other, instead of the conventional single beam. As shown below, where the two focused laser beams cross an interference pattern is produced. When this pattern exposes the photosensitive core layer, the interference pattern is imprinted into the refractive index of the glass, thus yielding a Bragg grating. Of course this UV laser spot containing the interference pattern is only a few microns across, so if the sample is moved by one grating period and exposed again, the length of the grating is extended. Repeating this simple process enables gratings of any length to be made. In reality the sample is not stepped, but moves continuously and the laser beam is modulated in synchronization with the motion of the sample.

### Direct Writing of Bragg Gratings

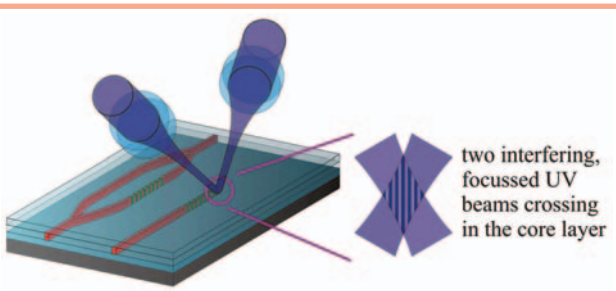
*Control of Bragg Grating Contrast (apodization)*

By changing the length of time that the laser is switched on during each exposure (mark-to-space ratio) it is simple to change the contrast in the gratings, from 100% to 0%. A grating with 100% contrast ratio is one where the refractive index difference between the core and cladding goes to zero at the grating minima. Other manufactures use a technique to write gratings by adding a grating to an existing waveguide; therefore making it impossible to produce such high contrast gratings. The ability to write gratings with high contrast enables Stratophase to write gratings with very high reflectivity. Since the laser spot that writes the gratings is just a few microns in diameter it is possible to accurately optimize the grating response by changing the contrast of the grating along its length – a process known as apodization.




*Control of Bragg Grating average index*

In addition to controlling the apodization of a grating, the average refractive index of the grating can be controlled by adjusting the laser intensity. By doing this, waveguides and gratings can be written with the same average index and thus avoid side bands in the grating response caused by Fresnel reflections from the change in average index.







Sales: 973-579-7227