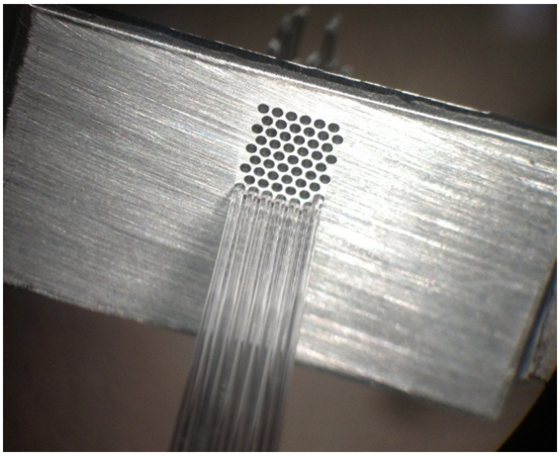
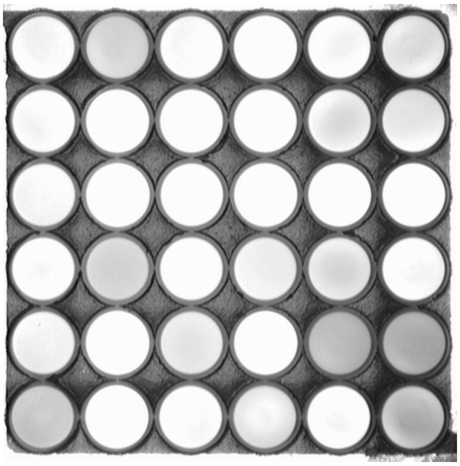
White Paper: 2D Arrays

Fiberguide has an extensive offering of fiber optic arrays. Arrays can be either a single line of fibers (1D) or multiple rows and columns of fibers (2D). The subject of this paper is 2D arrays.

2D arrays can be made by a number of different methods depending on the precision of the positional alignment of the fibers in the array. Fiberguide can choose and implement a specific method depending on the customer requirements. For example, if a customer would like to achieve a positional accuracy of 10µm-20µm with multimode fibers, a metal substrate with drilled holes can be utilized. A stacked fiber array can also achieve approximately the same accuracy with fiber to fiber positioning, i.e. no gap between fibers.



Drilled Mask Array



Stacked Array

To achieve tighter positional tolerances the array mask must be made in a Silicon wafer by way of a photolithography process. With this process you can expect to achieve positional tolerances of 0.5µm-2µm with single mode fibers.

There are a number of uses for 2D fiber optic arrays. One application is the telecom optical cross connect. Optical switching requires extremely demanding tolerances to channel light from

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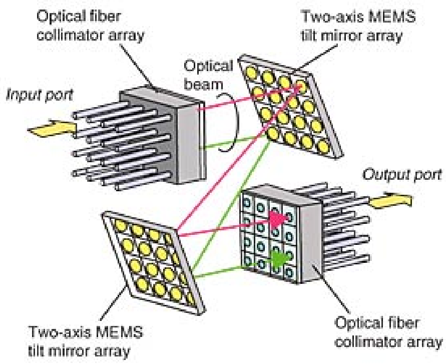
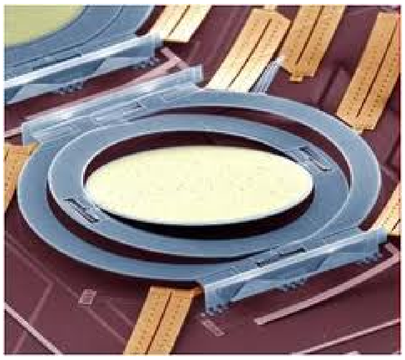
one fiber into another as well as rugged environmental requirements. To accomplish the alignment requirements Fiberguide engineers developed and patented a photolithographic process to create accurately sized and positioned holes in silicon substrates. Our patented silicon wafer arrays were originally designed to meet the needs of the telecom industry and specifically to meet Telcordia GR-1221-CORE-RELIABILITY qualification requirements. With this process we can achieve extremely accurate fiber positioning as well as excellent insertion and return loss specifications. Other important features include flatness over the whole face of the array of ≤ 1µm (25mm X 25mm area) and tightly controlled fiber angularity. Angular misalignment between fibers is as low as 2.5mRad with fiber to substrate as low as 5mRad.

Once the fibers are terminated in these substrates they are ground and polished, AR coated and a lenslet array is applied to collimate the light exiting the fibers. Light from one fiber can now be directed into another fiber by way of electromechanically actuated MEMS mirrors.



Typical Optical Cross Connect Switch

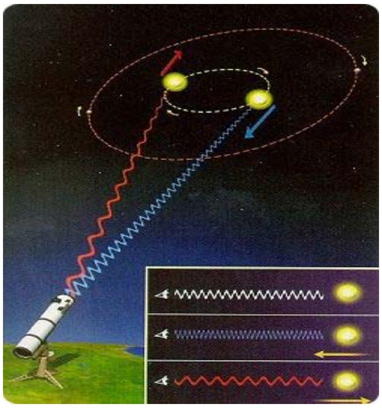


MEMS Tilt Mirror

Light traveling directly from fiber to fiber removes the need to have an optical-electrical conversion at the switch as in a typical hub. This provides for a more secure and quicker transfer of information. The resulting higher bandwidth is an important consideration as optical networks are forced to handle ever increasing data rates.

Another application for 2D arrays is astronomical mapping. Telescopes historically have been used to observe one source, or object, at a time. But with advancements in fiber optics they realized they could observe multiple objects at the same time. If an image is spread out on the active area of the array face, then each fiber can be independently analyzed by a spectrograph, and information about different locations on the image can be extracted. Each fiber in the array acts as its own effective 'camera,' gathering light from different areas of the target.

Fiber optic arrays in telescopes are useful in measuring the "red shift" of stars. Light frequency changes are observed as changes in color, so a star that moves away from earth appears redder; if it moves towards us, it appears bluer. Using spectroscopy, astronomers measure the red shift or blue shift of stars to understand their relative motion.



Drilled arrays can be used for many applications and are a lower cost alternative to silicon wafer arrays. For example large fiber spacing such as 9mm center to center can be used for microplate readers. Fibers are placed at the location of each well of the microplate and a flash lamp or other source is pumped through the sample to be measured. Absorbance and Fluorescence can then be measured on 96 wells at one time.

Microplate

Microplate Reader

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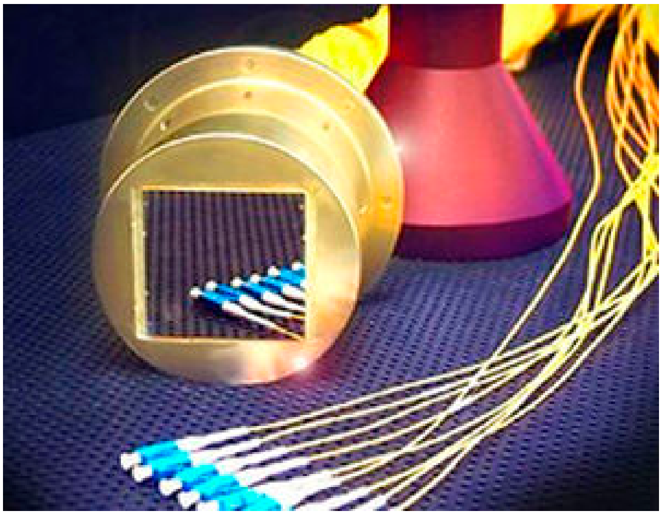
Other applications for 2D arrays include free space parallel interconnects, laser profilometry, optical coherence tomography for mapping and measuring as well as many other uses. So whether it's a high precision 2D array or an economical drilled or stacked array Fiberguide has an engineering and sales staff that is able to help you design and implement your ideas.



38 X 38 Silicon Wafer Array, Fibers On 1mm Centers

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