Monolithic, High-Speed Fiber-Optic Switching Array for Lidar

Electro-optic crystals allow for fast, multi-fiber switching without moving parts.

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Current fiber switch technologies use mechanical means to redirect light beams, resulting in slow switch time, as well as poor reliability due to moving parts wearing out quickly at high speeds. A non-mechanical ability to switch laser output into one of multiple fibers within a fiber array can provide significant power, weight, and costs savings to an all-fiber system.

This invention uses an array of crystals that act as miniature prisms to redirect light as an electric voltage changes the prism's properties. At the heart of the electro-optic fiber-optic switch is an electro-optic crystal patterned with tiny prisms that can deflect the beam from the input fiber into any one of the receiving fibers arranged in a linear array when a voltage is applied across the crystal. Prism boundaries are defined by a net dipole moment in the crystal lattice that has been poled opposite to the surrounding lattice fabricated using patterned, removable microelectrodes. When a voltage is applied across the crystal, the resulting electric field changes the index of refraction within the prism boundaries relative to the surrounding substrate, causing light to deflect slightly according to Snell's Law.

There are several materials that can host the necessary monolithic poled pattern (including, but not limited to, SLT, KTP, $LiNbO_3$, and $Mg:LiNbO_3$). Because this is a solid-state system without moving parts, it is very fast, and does not wear down easily.

This invention is applicable to all fiber networks, as well as industries that use such networks. The unit comes in a compact package, can handle both low and high voltages, and has a high reliability (100,000 hours without maintenance).

This work was done by Will Suckow, Tony Roberts, Gregg Switzer, and Chelle Terwilliger of AdvR, Inc. for Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15627-1