Optical Switches for Optical Communication System Using Electro-optic Effect in Ferroelectric Crystals

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In this paper, optical switches for optical communication systems are studied, using electro-optic effect in ferroelectric crystals.

A bulk type optical switch, constructed with a new electro-optic polarization converter, is proposed for multi-mode fiber links. Calculations and experiments are made for the polarization converter with $LiTaO_3$ crystal. A practical optical switch was obtained with a 5~40°C operating temperature range and a 3.6dB insertion loss, by improving the electrode of the converter and reducing polarization splitting loss. Wavelength selective switches also are proposed.

Waveguide type optical switches are studied for single-mode fiber switching networks. Design analysis for integration of directional coupler switches into an $LiNbO_3$ chip is made to construct matrix switches. Calculated results on switching voltage, waveguide radiation loss and interference effect between switch elements are described. New fabrication process for reducing the coupling loss to optical fibers is proposed. Based on the above considerations, several kinds of matrix switches were fabricated. A nonblocking 8x8 optical switch with 64 switch elements was obtained with low insertion loss below 8 dB. Basic experiments on space-division and time-division optical switching networks were performed successfully, by using the fabricated matrix switches. A polarization independent directional coupler switch with low switching voltage and a simple structure is proposed. This switch was applied to optical time domain reflectometer as a first practical waveguide type switch.

In conclusion, realization of optical switches for optical communication was confirmed.