Liquid crystal modulators on photonic integrated circuits

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Abstract

A photonic integrated circuit (PIC) or integrated optical circuit is a device that integrates multiple (at least two) photonic functions, being as such similar to electronic integrated circuits. The connections between components are made of light waveguides; these can be active themselves -i.e., light paths can be externally controlled- by using electrooptic (EO) materials within or onto the light path. The likelihood of liquid crystals to become EO materials for active waveguides in PICs has been explored.

A number of multimode interference coupler (MMI), Mach-Zehnder interferometers (MZI) and rings resonators (RRs) have been simulated, designed and manufactured [1]. PICs have been fabricated on silicon and glass. Waveguides have been arranged in the same wafer having widths 1.5-2 µm and lengths of active regions of 8-700 µm. In all cases, waveguides are made of SiO$_2$ (substrate) and SU8 (film), the cover being SiO$_2$, so that an LC structure can be eventually adapted onto the waveguide set.

Several LCs materials are being tested, with and without 3D-stabilization by a reactive mesogen. Reorientation of the LC mixture modifies the evanescent field of the guided light, effectively affecting the underneath light path. As a result, the MMI pattern, the MZI transfer function, and the RR resonant wavelength can be externally controlled.

Fig. 1. Light in waveguides

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