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.

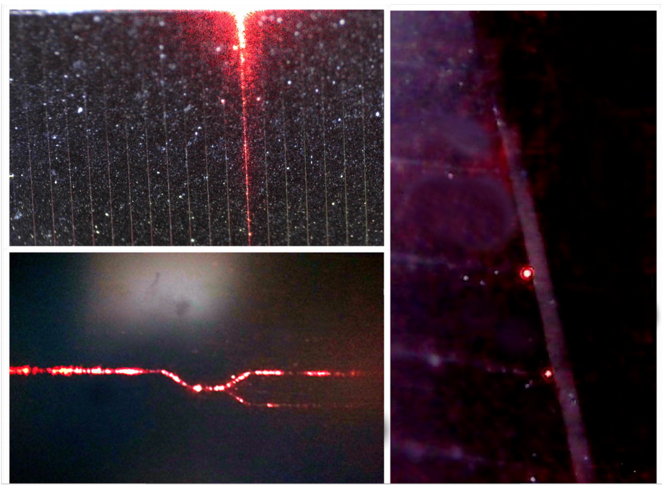

Fig. 1. Light in waveguides

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References

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