Fully-integrated optofluidic device on lithium niobate for liquid crystals actuation

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During the last years Optofluidic has attracted the interest of the scientific community due to its wide range of applications, from optics to biochemistry. In this field, one of the most exploited tool is the technology based on liquid crystals, due to their liquid nature, their optical properties and the high biocompatibility.
In this work we report our latest results on the realization of an optofluidic platform which is fully integrated on a lithium niobate (LiNbO3, LN) cell and allows actuating and monitoring liquid crystals by means of light [1]. The device consists of two part: the microfluidic channel which has been engraved on a Ti-doped LN substrate and the cover realized with a Fe-doped LN crystal. The Fe:LN cover allows reorienting liquid crystal molecules by means of the strong charge accumulations and electric fields which can be easily created at the surface of the material by light via the photovoltaic effect [2]. The diffused Ti:LN waveguides which cross the microfluidic channel are exploited to monitor the time evolution of the liquid crystals reorientation, thanks to the fact that this latter induces a **change of polarization** on the incoming light from the waveguide.
In this way the chip is able at the same time to optically control the liquid crystals alignment inside the microchannel and it reads the consequent light **polarization alteration** via an integrated waveguides system, thus increasing the level of integration and the full optical control of this system, paving the way for new interesting Lab-on-a-Chip and optical applications.

[1] Lucchetti, L., et al. "Light controlled phase shifter for optofluidics." *Optics letters* 41.2 (2016): 333-335.
[2] Carrascosa, Mercedes, et al. "LiNbO3: A photovoltaic substrate for massive parallel manipulation and patterning of nano-objects." *Applied Physics Reviews* 2.4 (2015): 040605.