PHOTOLITHOGRAPHIE DE RÉSEAUX MAGNÉTO-OPTIQUE À PROPRIÉTÉS MODULABLES PAR PIÉZO-ÉLECTRICITÉ

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ABSTRACT:

The integration of magneto-optical (MO) components on conventional platforms (glass, polymer, SOI or semiconductor) is a technological challenge that has persisted since the first demonstration [1].
Indeed, MO materials need heat treatments at more than 700°C, incompatible with their integration within optical chips having other functions. It has also been demonstrated that the use of a 1D structuring acting as a distributed Bragg resonator enhances MO properties [2]. Our recent works show the possibility of realizing micro/nano structured MO networks by deep-UV photolithography at RT of a nanocomposite with high MO properties based on a sol-gel doped with magnetic nanoparticles (NPM) and their integrations for applications in guided optics and in free space [3].
Modulation and parameter tunability of MO gratings allow not only a means to adjust for manufacturing errors but also a mechanism to increase device functionality.
The goal is to study and control the modulation of photolithographed magneto-optical networks deposited on a thin layer of piezoelectric material (by applying a voltage). It is more suitable to use ferroelectric polymer materials such as poly (vinylidene fluoride) as they don't require HT treatment [4].
Ultimately, the objective is the complete realization at LT of modular non-reciprocal optical components, hybrid piezo-network MO structures, with a complete study of their properties (piezo, MO, ME coupling).
Currently, at the early stages of this work, we are focusing on the piezo-electric layer. The main goal is the optimization of its PE properties, mainly by maximizing the beta phase of the PVDF. Multiple formulations and coating methods had been used, and interesting results had been obtained using characterization techniques (FTIR, XRD, AFM, SEM, Profilometer…), while the topography and roughness, must also be controlled.
Many other challenges await us, like combining the 2 layers, accurately controlling the mechanical variation of the PE layer, and maximizing the faraday rotation of the MO layer.

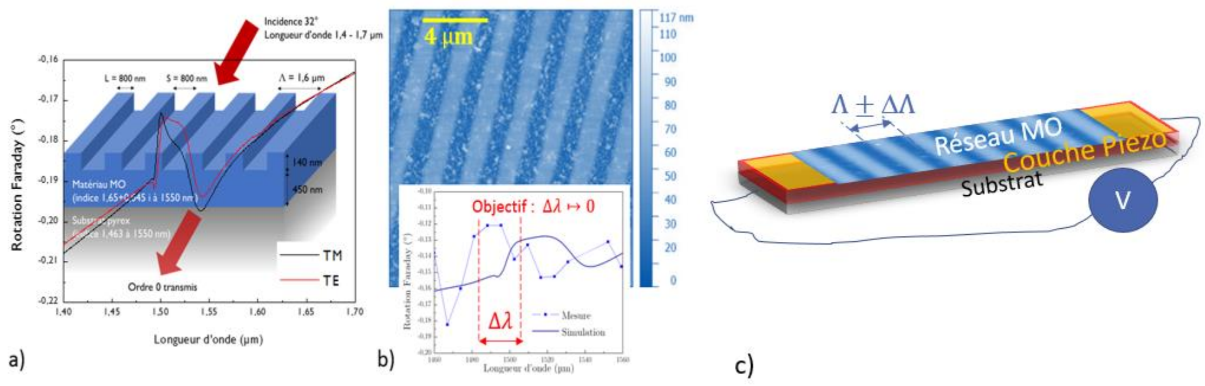

Figure 1: Simulation of a nanocomposite MO network (a), AFM image of a photolithographed network and measurement - simulation of its MO response (b), the device envisaged to modulate the MO properties using a piezoelectric layer (c).

References

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