INTEGRATED PHOTONICS ON LITHIUM NIOBATE THIN FILM

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Lithium niobate (LN) is an outstanding and versatile material for photonic/phononic circuits fabrication gathering high refractive index (≈2.2), broad transparency range (0.35-3.5 µm), nonlinear properties exploited through acousto-optic (≈74 pC/N), electro-optic (≈30 pm/V) and nonlinear-optic (≈27pm/V) coefficients. It has been widely used in bulk substrate or waveguides, to implement single building blocks as efficient frequency converters, high speed optical modulators, mechanical actuators and, above all, advanced photonics circuits [1, 2]. For the past decade, the development of LNOI (Lithium Niobate On Insulator) substrate has emerged as a major player in the field of integrated photonics [3]. Increased light confinement brought a whole new paradigm enabling more efficient frequency conversion, smaller waveguide bending radius, implementation of resonators [4,5], reduced voltage and increased bandwidth for light modulators. LN thin films can be fabricated by:

- direct epitaxial growth (thickness <500nm) [6],
- wafer bonding followed by lapping/polishing (thickness > 400 nm) [7],
- ion slicing, molecular bonding and polishing (thickness 300 to 900 nm) [8].

So far, the LNOI wafers for photonic applications are mainly produced using the ion slicing process or the bonding/polishing and are provided only by a few companies (NanoLN and Pam Xiamen in China, Partow in the USA, NGK Insulators in Japan), and are still expensive (several k€ each wafer). On the other hand, the microfabrication of devices based on LN films is already mastered by several academic and industrial institutions (CSEM Swiss, Inphotec Italy, Phase Sensitive Innovations USA, Hyperlight USA…).

Within the framework of the France 2030 program "PEPR Electronics", dedicated to ensuring national sovereignty for strategic technological fields, the need to develop a national sector for elaboration of LN films and specific microfabrication methods for integrated photonic chips has been identified. Hence, the French national network RENATECH and the research laboratories working on LN materials and devices will join the forces to address the critical LN technology developments (**fabrication of thin films** and **periodically poled structures**, **micro-structuring**, and **co-integration with semiconductor** technologies) necessary for next generation integrated photonic and quantum devices in order to supply structures, devices and circuits based on LN films for the national academic and industrial communities.

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