

Engineering of LiNbO₃ films for next generation acoustic and energy harvesting applications

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The next generation of high –frequency wide-band RF filters or frequency-agile filters are urgently needed for the development of 5G infrastructures/networks/communications. Today, LiNbO₃ and LiTaO₃ single crystals are key materials in electro-optics and RF acoustic filters. This motivates further development of acoustic wave devices based on highly electromechanically coupled LiNbO₃ thin films, adapted to the high-frequency applications. The challenges and the achievements in the epitaxial growth of LiNbO₃ films and their integration with Si technology and to acoustic devices will be discussed in detail. The deposition techniques enabling the control of film composition/nonstoichiometry of volatile alkali metal oxides & the methods of compositional analysis will be presented. A particular effort was done to achieve the epitaxial growth of films with single controlled orientation and nearly stoichiometric Li₂O composition. We have demonstrated an extremely high acoustical performance compatible with filter applications for SAW devices, based on epitaxial LiNbO₃ films, operating in the frequency range around 5 GHz. Future prospects of potential applications and the expected performances of thin film acoustic devices are overviewed, as well. Moreover, it was demonstrated that the power density of 9.62 mW .cm⁻³ (comparable to present performance of lead-based piezoelectric harvester) can be harvested by vibrational energy transducer based on thick LiNbO₃ films. Thus, LiNbO₃ films might be a lead-free alternative for PZT in vibrational energy harvesters, as well.



Ausrine Bartasyte is an associate professor—chair of excellence of Labex ACTION at the Institute FEMTO-ST, University of Bourgogne Franche-Comté (Besançon, France). A. Bartasyte has an experience of 17 years in deposition of epitaxial multifunctional oxides and their heterostructures (superconductors, mixed conductors, high-k dielectrics and ferroelectrics). She received her Ph.D. in 2007 from Grenoble Institute of Technology. She was a postdoctoral research assistant in Prof. A. M. Glazer's group at the University of Oxford, UK, working on the crystal growth of LiNbO₃–LiTaO₃ solid solutions. She took her sabbatical leave to Harvard University. At present, her research is focused on engineering of structural and physical properties of alkaline niobate/tantalate single crystals, films, heterostructures & nanostructures for miniaturized and/or integrated devices with better performance in acoustics, optics and energy harvesting.