



**Title :** Advanced Piezoelectric Alkaline Niobate Architectures for the Next Generation Ultra-Wide Band and Tuneable Acoustic RF Filters (PhD2 Physics)

**Keywords :** Electrical characterisation, physical properties, piezoelectricity, acoustic waves, ferroelectricity

**Description of Laboratory/University :**

**University of Bourgogne Franche-Comté** (UBFC, [www.ubfc.fr](http://www.ubfc.fr)) is a multidisciplinary university established in different parts of the region Franche-Comté. **FEMTO-ST institute** ([www.femto-st.fr](http://www.femto-st.fr)) is a multidisciplinary research institute made up of six departments covering numerous domains of engineering sciences and including more than 500 scientific, administrative and technical support staff. About 225 PhD students receive a high-level training in scientific research. It is one of the most competitive research institutes in France and is among the leaders in the world on Engineering for micro and nanoscale. The institute is a major actor of the industrial pole “Microtechnics” in the Franche-Comté region. One of the key research topics at FEMTO-ST Institute is the development of devices based on electraactive materials with particular emphasis on microelectromechanical systems (MEMS), photonics, electro-optics, phononics, acoustics and robotics. FEMTO-ST institute has a microfabrication technology center with clean room facilities MIMENTO mixing technologies from microelectronics to micromechanics. MIMENTO is a member of the national network of seven largest clean rooms in France (RTB).  
More details about research group can be found @ <http://members.femto-st.fr/ausrine-bartasyte/>

**PhD topic**

The “ANTARES” project (financed by French I-SITE program ‘Investment for Future’) tends to contribute to the race towards 5th generation (5G) telecommunication applications, which will be highly beneficial for society by opening wide possibilities for internet-of-things, data transfer, extreme device density, smart transport/cities and communication systems, V2X applications, etc. The next generation of high –frequency wide-band RF filters or frequency-agile (tunability of central frequency) filters are urgently needed for the development of 5G infrastructures/networks/communications. This motivates further development of robust bulk acoustic wave (BAW) filters, adapted to the high-frequency applications. The bottleneck of the present BAW filter technology is very limited electromechanical coupling of available thin film materials. Alkaline niobates (LKN) were identified theoretically as the materials with highest available  $K^2$  of BAW, but LKN thin films are still not available due to major issues in their synthesis. To achieve LKN films with thihg  $K^2$ , ANTARES proposes an innovative approach – the development of functionally graded piezoelectric layers (FGPL) and multi-layered structures (MLS) based on LKN in line with advanced methods such as chemical engineering, control of orientation through epitaxy, strain and domain engineering. FGPL/MLS may offer a new possibility to increase significantly  $K^2$  and quality factor, to reduce acoustical losses, and to ameliorate stability at high power densities. FGPL/MLS will be also used to eliminate out-diffusion of alkali metal oxides and ferro-elastic domain formation. To implement newly developed materials to BAW filters, multidisciplinary approach implying chemistry, material science, microtechnology, physics and acoustics will be applied. ANTARES will contribute to the fundamental understanding on physical properties of FGPL/MLS and consequently acoustical performance in order to enable advanced design of future materials.

**PhD objectives**

- Understanding of a relationship between microstructure of the layers and their macroscopic and nanoscale physical properties
- Development of microfabrication technology for BAW structures based on thin films
- Simulation, design and characterization of basic BAW resonators based on developed innovative architectures

**Starting date:** as soon as possible (latest starting date September 2019)

**Offer requirements**

Education level: Master degree or equivalent in Material science /Physics/Engineering/Electronics or a related subject, which formally entitle to embark on a doctorate;

Qualifications & experience:

- Fluent English (oral and written); PhD thesis will be written in English;
- Excellent IT skills (Microsoft office, image editors);
- Background and expertise in the field of Material Science and/or Engineering/Physics/Electronics;
- Experience in RF frequencies, acoustics, electrical characterisation and microfabrication (optional)

Personal skills:

-High motivation, excellent interpersonal skills, good time and stress management, excellent written and oral skills.

**How to apply :**

CV, motivation letter, recommendation letter from Master supervisor, official transcripts of master (1st and 2nd year) and bachelor/license records and rankings (including total number of students in cursus) have to be emailed to [ausrine.bartasyte@univ-fcomte.fr](mailto:ausrine.bartasyte@univ-fcomte.fr)

Dr. Ausrine Bartasyte  
Chaire d'excellence du Labex ACTION  
Institut FEMTO-ST, Université de Franche-Comté  
26 rue de l'Épitaphe  
25030 Besançon  
France  
Tel. +33 3 81 40 28 24  
[ausrine.bartasyte@univ-fcomte.fr](mailto:ausrine.bartasyte@univ-fcomte.fr)