



MASTER STUDENT INTERNSHIP IN DIELECTRIC TUNABILITY OF SOL-DERIVED PZT FILMS AT MM-WAVE FREQUENCIES (M/F)

Internship | 6 months | Fulltime/40h | Belvaux

Context

The Materials Research and Technology department (MRT) focuses on two key enabling technologies: nanotechnologies and advanced materials, and investigates research questions related to transducing materials and actuators, photocatalysis and energy harvesters, transparent electronics and smart nanocomposites, point-of-care and drug delivery, modeling and design of structures and multifunctional composites, bio-based polymers and composites, adhesion and compatibilization of fibres/matrix, process engineering and advanced manufacturing.

The 'Ferroic Materials for Transducers' (FMT) group has developed a novel method of depositing high-quality transparent films of lead zirconate titanate ($\text{Pb}[\text{Zr}_x\text{Ti}_{1-x}]\text{O}_3$, PZT) on glass. The films display high dielectric permittivity that can be changed by application of an electric field. They are typically employed in applications up to radio frequencies; it is unknown if their usefulness extends to the frequency range of mm-waves, i.e. to between 30 GHz and 300 GHz. Coplanar waveguides (CPW) of PZT have been designed using the COMSOL software, deposited on the films, and shown to display reasonable transmission at frequencies from 30 GHz to 110 GHz.

Description

The aim of the present internship is to investigate and understand the electrical tunability of CPW structures on PZT films. Based on the existing COMSOL model, changes of the electrical properties of these structures under an electrical dc bias field will be determined. The results can serve as a base for the later development of more complicated functional structures such as tunable filters or resonators.

The work of the intern will consist in the following tasks

- Design of the CPW structures to be deposited on the piezoelectric layer in order to obtain impedance-matching to the 50 Ohm ports of a Vector Network Analyser (VNA). This step will be performed by finite element simulation (COMSOL). The structures will then be realised by photolithography by other group members.
- Measurement of the scattering-(S-)parameters using a 2-port VNA both at zero bias and under a constant bias voltage of a few volts.
- Deduction of changes to the dielectric permittivity under field from S-parameters using the COMSOL model.
- If tunability is sufficient, the COMSOL model will be used to design an electrically tunable filter based on PZT films.

The intern will have the opportunity to perform multidisciplinary work in state-of-the-art clean room and characterization facilities of LIST. He/she will have access to different characterization techniques, including scanning electron microscope, X-ray diffractometer, profilometer, ferroelectric, piezoelectric and vibrometer testers and dielectric spectroscopy across of frequency range spanning 15 orders of magnitude. It is expected that the results of the work will be communicated in a presentation in the FMT group seminar as well as a detailed written report to be submitted at the end of the internship.

Job reference: MRT-2020-Intern-009

Application file:

- A CV
- A motivation letter

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Contact: jobs@list.lu

Your working environment

The research department

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Profile

Education

- Last year undergraduate student (Master 2) in Materials Science or Electrical Engineering with interest in Materials Science

Competencies

- Ideally, knowledge on the functioning of a Vector Network Analyzer and/or COMSOL software package

Language

- English is mandatory
- German is an asset

The Luxembourg Institute of Science and Technology (LIST) is a mission-driven Research and Technology Organisation (RTO) that develops advanced technologies and delivers innovative products and services to industry and society. Located at the heart of Luxembourg's vibrant Research and Innovation Campus in Esch-Belval, LIST can ideally connect its over 500 specialists in materials, the environment and IT with virtually all of Luxembourg's other main research players such as the University of Luxembourg, LIH, LISER, Technoport, Luxinnovation and the National Research Fund. **LIST.lu**

The LIST is committed with equality of opportunities and gender balance