

DEDALE

Title of the thesis
Development of compact and frequency agile antennas by the use of lead-free ferroelectric materials
Funding
Contrat Doctoral Ordinaire Université de Rennes 1
Location of the thesis
FunMAT team, Institut d'Electronique et des Technologies du numEriques (IETR) UMR CNRS 6164, IUT Saint Brieuc, Université Rennes 1
Duration of the thesis
October2021 – September 2024
Required profile
<p>Master 2 / Ecole d'Ingénieur :</p> <ul style="list-style-type: none"> ▪ Materials ▪ Chemistry of solids ▪ Physic, Physic– Instrumentation, Nanosciences – Nanomaterials - Nanotechnologies ▪ Technologies of information, Systems of communications ▪ Electronic
Context of the thesis
<p>We synthesized, in the FUNMAT team of IETR on the site of Saint Brieuc, a new ferroelectric material with formulation $(\text{Sr}_2\text{Ta}_2\text{O}_7)_{100-x}(\text{La}_2\text{Ti}_2\text{O}_7)_x$ (STLTO) (Thesis Florent Marlec, 2015 -2018 [1,2]). The thesis of Mohamad Haydoura (2018-2021) has allowed the characterization of this material in the form of ceramics in the field of microwaves, and is currently continuing with their integration into simple antenna devices: dielectric resonator antennas [3]. Works are also done on thin films [3]. The purpose of the future thesis is to concretize the application potential of the material through the design, manufacture and characterization of optimized antenna prototypes based on ceramic and thin films of the STLTO material, in order to increase the level of technological maturity of this research topic.</p>
Objectives and organization of the thesis
<p>The purpose of the thesis is to study and optimize jointly the materials and the antenna applications. On the one hand, the optimization of compact antennas based on dense ceramics STLTO will be conducted, playing both on the topology of the antenna and on the properties of the material via its flexible chemical composition. New phases will be also addressed, with the development, for instance, of SrTa_2O_6 ceramics, with lower dielectric losses. On the other hand, the tunable aspect of the ferroelectric STLTO will be exploited, by depositing these materials in the form of thin layers. A new co-sputtering apparatus with elementary targets will be used to adjust the cationic composition. We are aiming for the deposit of perovskites STLTO phases, presenting the best tunability of the dielectric permittivity. Low loss, tunable and miniature planar antennas will thus be developed. For the different devices cited, the design will target work frequencies adapted to 5G and 6G antennas applications.</p>
References :
<p>1] Florent Marlec, Nouveaux matériaux perovskites ferroélectrique : céramiques et couches minces issues de la solution solide $(\text{Sr}_2\text{Ta}_2\text{O}_7)_{100-x}(\text{La}_2\text{Ti}_2\text{O}_7)_x$, Thèse de l'Université de Rennes 1 (2018). http://www.theses.fr/2018REN1S024/document</p> <p>[2] Florent Marlec, Claire Le Paven, François Cheviré, Laurent Le Gendre, Ratiba Benzerga, Benoît Guiffard, Thibaut Dufay, Franck Tessier, Bachir Messaid, Ala Sharaiha, Ferroelectricity and High Tunability in Novel Strontium and Tantalum Based Layered Perovskite Materials,</p>

Journal of the European Ceramic Society, 38 (2018) 2526-2533.

<https://doi.org/10.1016/j.jeurceramsoc.2018.01.033>

[3] M. Haydoura, R. Benzerga, C. Le Paven, L. Le Gendre, V. Laur, A. Chevalier, A. Sharaiha, F. Tessier, F. Chevire, Perovskite $(\text{Sr}_2\text{Ta}_2\text{O}_7)_{100-x}(\text{La}_2\text{Ti}_2\text{O}_7)_x$ ceramics: from dielectric characterization to dielectric resonator antenna applications, Journal of Alloys and Compounds 872 (2021) 159728.

<https://doi.org/10.1016/j.jallcom.2021.159728>

[4] L. Le Gendre, C. Le Paven, M. Haydoura, R. Benzerga, F. Marlec, A. Sharaiha, F. Chevire, F. Tessier, A. Moréac, Thermal oxidation of oxynitride films as a strategy to achieve $(\text{Sr}_2\text{Ta}_2\text{O}_7)_{100-x}(\text{La}_2\text{Ti}_2\text{O}_7)_x$ based oxide perovskite films with $x = 1.65$, Journal of the European Ceramic Society 40 (2020) 6293–6300.

<https://doi.org/10.1016/j.jeurceramsoc.2019.12.023>

Thesis direction

- Director: Claire Le Paven, MCF-HC IETR / IUT Saint Briec / Université Rennes 1
- Co-director: Ala Sharaiha, PR IETR / Université Rennes 1

Contact and application

The application file must include a detailed CV, a motivation cover, and the transcripts of Master training. A letter of recommendation may be attached to the file.

All documents should be addressed to:

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