

# Ferroelectric oxides for energy efficient embedded non-volatile memories



**NICOLAS BAUDIN**  
INTERNSHIPS IN FRANCE INITIATIVE

Ecole Centrale de Lyon + STMicroelectronics

<b>Name of the hosting institution in France</b>	Ecole Centrale de Lyon
<b>Name of the host laboratory / research team</b>	Institut des Nanotechnologies de Lyon
<b>Address</b>	36 avenue Guy de Collongue 69134 Ecully
<b>Web site</b>	<a href="http://www.inl.cnrs.fr">www.inl.cnrs.fr</a>
<b>Name of the supervisor</b>	VILQUIN Bertrand
<b>Function</b>	Associate-Professor
<b>Email</b>	bertrand.vilquin@ec-lyon.fr
<b>Phone number</b>	+33 6 30 61 15 70

## Internship offer

**Topic of the internship (title)** | Ferroelectric oxides for energy efficient embedded non-volatile memories

**Proposed dates of the internship** | **Start:** 2019-09-02 | **End** 2019-12-02

**Scientific and academic objectives of the internship (detailed description of the internship content, work expected from the intern and expected outcomes):**

The project is researching energy efficient non-volatile memory (NVM) based on Si-compatible ferroelectric (FE) HfZrO<sub>2</sub> to provide advanced embedded solutions for normally-off microcontroller units (MCU) used in Internet of Thing. The project involves academic laboratory partnering the major semiconductor industrialist STMicroelectronics to address the complex issues associated with materials optimization and device fabrication and characterization. Our final goal is to replace Flash NVM in normally-off MCUs with faster and less power consuming ferroelectric memories. The master's project will be dedicated to the ferroelectric oxide fabrication and characterization. The materials strategy is to use Si-compatible, FE HfZrO<sub>2</sub> which will has excellent prospects for manufacturability and cell size scaling. Introducing new materials and device architectures often creates a lot of unknowns we will address during this challenging project. The master student will learn what it takes to make a competitive FE-HfZrO<sub>2</sub> –based FeRAM that retains the merits of conventional perovskite-based FeRAM but overcomes their shortcomings. Thanks to the internship, we expect to learn whether the FE HfZrO<sub>2</sub>-based memory offers performance advantages compared to other NVM rivals. One of the big unknowns is the high endurance requirement. A second key point for manufacturability is whether ferroelectricity in this material can be achieved at temperatures that allow BEOL integration with CMOS. Emphasis is given on the compatibility with Si processing. Various growth methods will be used as well as advanced structural and electrical characterization to determine the factors limiting reliability of ferroelectric memories.

<b>Name of industrial partner</b>	STMicroelectronics (STM-Crolles)
<b>Role of the industrial partner in the internship project</b>	The industrial will participate to the project meeting and will provide patterned silicon wafers for further deposition of the FE HfZrO <sub>2</sub> deposition at the academic laboratory.
<b>Main contact at the French industrial partner</b>	JEANNOT Simon
<b>Main contact at the French industrial partner's branch in Australia</b>	Frédéric Dot
<b>Name of the Australian partner institution</b>	RMIT Melbourne
<b>Name of lab/department/team involved in the collaboration at the Australian partner institution</b>	RMIT Micro Nano Research Facility (MNRF) and School of Engineering
<b>Main contact in the Australian partner institution</b>	MITCHELL Arnan
<b>Function of the main contact in the Australian partner institution</b>	Director (MNRF) and Distinguished Professor
<b>Email address of the main contact in the Australian partner institution</b>	arnan.mitchell@rmit.edu.au
<b>Outside of this ongoing collaboration, will applications coming from students of other eligible Australian universities be considered by the hosting institution in France?</b>	No

## Expected profile of applicant

<b>Level of study</b>	Master's student
<b>Discipline</b>	Physics ; Electronic Engineering; Material Science and Engineering
<b>Required qualities, knowledge and skills</b>	The candidate should have good knowledge in material science and technology. Skills in structural characterizations and clean room will be appreciated but is not formally needed.