PhD Position: **Mott Memory Technology**

Nowadays, the need of a data storage infrastructure allowing Big Data processing requires **memory devices with improved performance**. One way to improve the performance of electronic devices is to introduce **new materials and physical concepts**. CEA-LETI and IMN (Institut des Matériaux de Nantes) have recently developed a new class of non-volatile resistive memory: **Mott Memory**. Indeed, IMN researchers have discovered the possibility of generating electrically field induced resistive transitions in Mott insulators, such as GaV_4S_8 and $(V_{1-x}Cr_x)_2O_3$. Studies show that this resistive switching is based on an electronic mechanism confined to the nanoscale. Mott Memory may have a significant advantage over conventional resistive memory based on metal oxides (OxRRAM) or phase change materials (PCRAM). The electrical results of very simple Mott Memory devices (TiN/$(V_{1-x}Cr_x)_2O_3$/TiN) show very good performances in terms of programming speed, consumption and reliability. The proposed PhD is therefore part of an ambitious project between CEA-LETI and IMN to **confirm the high potential of Mott insulators for Memory applications** and for **Artificial Intelligence applications**. It targets **integration of Mott insulators in a Memory Advanced Demonstrator (MAD) in CMOS technology** to perform systematic statistic performance analysis.

The PhD candidate will contribute to **optimization of Vanadium Oxide Mott Memory by studying material properties until in-depth electrical characterization of Mott Memory devices** integrated in CMOS technology.

In parallel, the development of thin film deposition and electrical characterization of **other Mott insulators at IMN** will look for alternative choices to $(V_{1-x}Cr_x)_2O_3$ prior to their integration on electrical wafers at CEA-LETI.

The different tasks will be:

Physicochemical (XRR, XRD, XPS, SEM, TEM...), and **electrical** (resistivity, transport) **characterizations** on **thin films of Mott insulators** (Cr-doped V_2O_3 …) annealed and encapsulated. Different deposit techniques will be studied at IMN and at CEA-LETI.

Development and Electrical Characterization of integrated Mott Memory devices, from single device analysis to full matrix statistics. Optimization **programming parameters** (electrical pulses, amplitude, time, frequency...) to improve **memory performance** (window, endurance, retention) and to identify the best material parameters (thickness, Cr concentration...).

Physical interpretation based on electric Mott transition mechanisms and **multi-physical simulations** to correlate the device performances with the material properties.

Scientific environment:

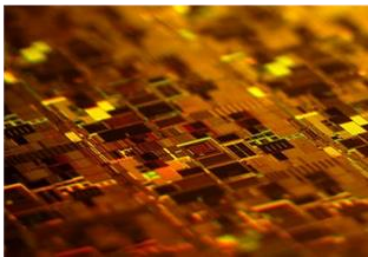
The candidate will work mainly at CEA-LETI in Grenoble in strong collaboration with IMN laboratory. **Work periods will take place at the IMN in Nantes**, and will be chosen according to the progress of the work. The candidate will join teams with experts in various domain (Mott insulators, electric Mott transition, memory device integration, physicochemical and electrical characterizations, modelling and design). Good team spirit to interact efficiently with the CEA-LETI and IMN teams' members will be required.

Requested skills and education

The candidate must be graduated from an engineering school and/or with a Master 2 degree whose training focuses primarily on materials science, physics, electronics or related field. The PhD subject requires a large part of experimental work and a good scientific level in material science, electronic devices, physicochemical and electrical characterizations techniques

We are looking for a highly motivated student with a strong interest and capacities in experimental work, materials science and electronic devices. Interpersonal skills, dynamism, rigor and teamwork abilities associated to a rapid work in autonomy will be appreciated. Candidates should be fluent in English and/or in French. In addition, well-written English will be highly appreciated. A previous internship experience in material sciences research and/or electrical characterizations are expected.

Department: CEA-LETI, 17 rue des Martyrs 38054 Grenoble CEDEX 9
Laboratory: Memory Device Laboratory
Start Date: 10/2019
Contact: eric.jalaguier@cea.fr
Benoit.corraze@cnrs-imn.fr



The LETI environnement

A unique scientific, industrial and cultural environment, With its research centers, university campus, 500 foreign companies and 40000 scientists, engineers and technicians employed in the area, the Grenoble-Isère region, otherwise known as the French Silicon Valley, mixes world-class intellectual and scientific dynamism with exceptional quality of life. It is the ideal springboard for LETI's expansion. Located in the heart of a unique scientific, industrial and cultural environment, the CEA-LETI Institute for micro- and nanotechnology research offers researchers alike a rewarding place to work. You will grow in an environment where the scientific community is passionately engaged in technological research: men and women who are ready to share their expertise with you in your scientific and professional development. From technologies to applications, LETI is a world leader in the creation and transfer of innovation within Europe. With 2800 patents, its intellectual property portfolio is unusually rich for a research institute.

With MINATEC, LETI boasts a concentration of resources that is unrivalled in Europe. An international benchmark in micro- and nanotechnology, the MINATEC Campus is home to state-of-the-art infrastructure and equipment that is available to every researcher working at LETI. LETI's special place in the global research community is partly due to its natural surroundings in the heart of the French Alps, which offer an excellent quality of life. Leading experts who have been attracted to this natural environment have helped LETI form its mutually rewarding industrial alliances that provide students an unmatched learning experience (http://www-leti.cea.fr/en).