2021-2022 Internship proposal at TIMA & LMGP Labs.

Analysis of the efficiency of LaNiO4 memristive devices for bio-inspired learning

Abstract

A memristor (short for Memory-Resistor) is a two-terminal memory device that stores information in terms of high/low resistance. It is able to retain information even when the power source is removed, i.e., it is non-volatile. In the last decade, memristors have received special attention due to (1) their potential of implementing storage class memories or even non-volatile main memories and (2) their potential to implement logic and arithmetic functions within memory array (leading to the raise of In-Memory Computing and Neuromorphic Computing paradigms). In order to demonstrate the usability of memristive device in a circuit or application, a comprehensive and precise electrical model of such a device needs to be devised.

Project description

This internship is concerned with the **analysis of LaNiO4-based memristive devices and the evaluation of their ability to serve as synapses for neuromorphic computing** with bio-inspired, on-line, unsupervised learning (such as Spike Timing Dependent Plasticity - STDP). These individual memristive devices (Fig 1a) are currently being developed at LMGP, and have shown very promising analogue-type switching (Fig 1b) and conductance modulation properties which could emule the depression and potentiation of the synaptic weight (Fig 1c). However, the development of an electrical model for these devices has not been carried out yet.

Tasks of the internship:

- Perform electrical measurements of the memristive devices to optimize the pulses' characteristics for an optimal potentiation/depression signature (at LMGP).

- Analyse the synaptic behavior of such a device and evaluate its efficiency in a very small network to identify the advantages of using these devices and to conclude on its advantages and shortcomings (at TIMA).

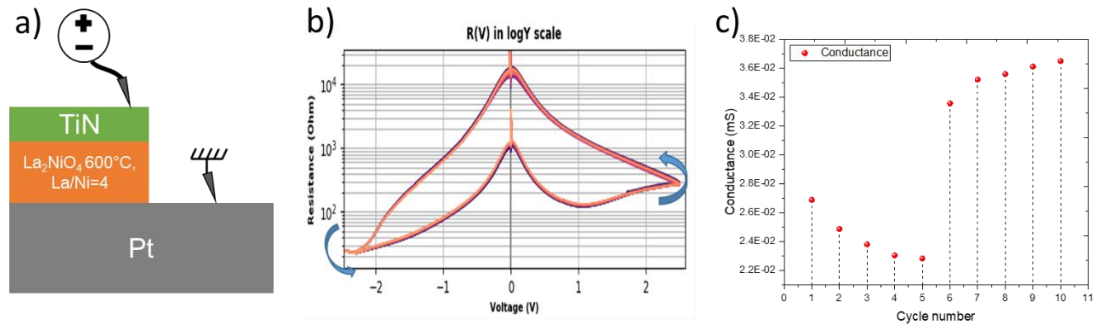

Figure 1 a) La2NiO4-based memristive devices; b) Analogue-type mermirsive behaveiour ; and c) conductance modulation

Scientific environment:

The candidate will work within the LMGP, Materials and Physical Engineering Laboratory, in the *Oxides for Nanoionic Devices* group (https://lmgp.grenoble-inp.fr/en/research/oxides-for-nanoionic-devices) within the *Nanomat Team*.
Located in the heart of an exceptional scientific environment, the LMGP offers the applicant a rewarding place to work.
LMGP Web Site: http://www.lmgp.grenoble-inp.fr/
The second half of the internship will be within the TIMA Laboratory, the AMFORS (Architectures and Methods for Resilient Systems) group. TIMA Web Site: http://tima.univ-grenoble-alpes.fr/tima/fr/index.html

Profile & requested skills:

We are looking for a highly-motivated Engineering School or M2 Masters student. Applicants must have a Master 1 (or equivalent) not older than 3 years at the application deadline in a related field of microelectronics technologies, semiconductor physics and modelling and/or new advances in Artificial Intelligence. Interpersonal skills, dynamism, rigor and teamwork abilities will be appreciated. Candidates should be fluent in English and/or in French and have good English writing skills.

Allowance: Internship allowance will be provided

Application instructions

If you are interested in the topic please send your complete application to the 3 contacts below.

A complete application consists of:

Cover page: Short motivation of the applicant and connection with the position, including how this position serves future career goals. Include name and contact information of applicant (1 page max)

CV: Academic and professional background, detailing relevant experience, particularly research.

Relevance for Application: The applicant should include a clear description of how his or her scholarly background and expertise is applicable, and might add value, to the project set out above.

Our team welcomes applicants with diverse backgrounds and experiences. We regard gender equality and diversity as strength and an asset.

Depending on the student's motivation, the internship may lead to a doctoral project.

CONTACTS

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