

**Job title:** Postdoctoral Research Fellowship

**Title:** EPRINT - Mott materials at the nanoscale for Neuromorphic systems

**Location:** Institut d'Electronique, de Microélectronique et de Nanotechnologies (IEMN-CNRS), Lille, France

**Duration:** 2 years

**Closing date:** May 2, 2023

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**Gross living allowance:** 2800 € gross per month + advantages

Neuromorphic systems hold great promise for reducing power consumption and for creating new applications beyond the reach of conventional computers. To date, each artificial neuron is composed of thousands of transistors. The use of Mott insulators, a class of materials with fascinating non-linear properties, could significantly reduce the complexity of the circuit, reducing the number of components per neuron and per synapse to one.

The present postdoc project aims at developing an accessible circuit writing, by scanning a polarized conductive nanoscale tip. This has already been demonstrated by scanning tunnelling microscopy (STM), and could also be achieved using an atomic force microscope equipped with a conductive tip (C-AFM). A good understanding and control of the electro-induced transitions in Mott materials ( $\text{GaTa}_4\text{Se}_8$  or  $\text{TaS}_2$  crystals,  $\text{V}_2\text{O}_3$  or  $\text{TaSe}_2$  films) will be first developed. The objective of the project is the realization of a complete monolithic neuromorphic circuits by electric pulse on the surface of Mott materials. An exploratory project on superconducting circuits written at the surface of  $\text{GaTa}_4\text{Se}_8$  may also be targeted depending on the candidate expertise.

The fellowship is funded by the ANR NANODYN and CPER IMITECH.

## Context

The team Physics of Nanostructure Devices works on the electrical and optical properties of promising nanomaterials, with both fundamental and device-oriented approaches. We currently have 4 permanent researchers, 1 research engineer, 1 Postdoc and 3 PhD students, working in strong connection with all the members of the Physics group.

IEMN is a research institute created by the National Centre for Scientific Research (CNRS), two universities and an engineer school of France northern region. IEMN is part of the RENATECH network and as such, the equipment for design, fabrication and characterization of micro/nano devices are at the best european level. The institute has a total staff of about 500 persons including 150 permanent researchers, 100 engineers and administrative agents, about 150 PhD students. The lab is very open to international collaborations; more than 100 foreigner scientists coming from 20 different countries are currently working at IEMN. The IEMN scientific activity covers a large domain going from the physics of materials and nanostructures to microwaves, telecommunications and acoustics instrumentation.

The City of Lille. Lille offers an attractive living environment while being a student city of more than a million inhabitants. Furthermore, it sits at the crossroad of three capital cities of Europe (Paris, London and Brussels being reachable within an hour train ride).

*Website:* <https://www.iemn.fr/la-recherche/les-groupes/physique/nanostructures-quantum>

## Person Specification

A PhD degree in Physics or a related discipline and a background in Solid State Physics are required. We are seeking for a talented, enthusiastic F/M candidate with excellent analytical skills, having proven experience in one or more of the following items:

- Near field microscopy and spectroscopy
- Strongly correlated electronic systems
- Implementation of neuromorphic devices
- Mott based superconductivity