



## PhD Position – Fabrication of 3D antennas for radio-frequency energy harvesting



**Laboratories : IMT Nord Europe\_Center for Materials & Processes & IMT Atlantique\_Optical Department**

**Line Managers : Dr. HDR Cédric SAMUEL, Dr. Sébastien CHARLON, Pr. Fabrice SEGUIN & Dr Alexandre KHALDI**

**Workplace : Douai & Brest**

**Type of contract and duration : PhD contract, 36 month**

### **CONTEXT :**

Public establishments belonging to IMT (Institut Mines-Télécom), placed under the supervision of the Ministry of Industry, IMT Nord Europe (IMT NE) and IMT Atlantique (IMT A) has three main objectives: providing our students with ethically responsible engineering practice enabling them to solve 21st century issues, carrying out our R&D activities leading to outstanding innovations and supporting territorial development through innovation and entrepreneurship. IMT NE and IMTA have strong ambitions to become main actors of the current industrial transitions, digital and environmental, by combining education and research on engineering and digital technologies.

For more details, visit the School's websites : [www.imt-nord-europe.fr](http://www.imt-nord-europe.fr) & [www.imt-atlantique.fr](http://www.imt-atlantique.fr)

The collaboration between IMT NE and IMT A leverages complementary expertise to fabricate functional devices based on rectennas for harvesting energy from radiofrequency waves (RF). The core components of the rectenna include a polymer substrate and electronic devices.

Indeed, the Center for Materials and Processes (CERI MP) at IMT NE provides extensive expertise in understanding the relationship between polymer structure, processing, and properties, which is essential for developing a polymer substrate with the required characteristics. Meanwhile, the Optical Department (OPT) at IMT A has been actively involved for several years in advancing next-generation electronic devices, including radiofrequency energy harvesters.

We are looking for a highly-motivated PhD candidate with a Master degree in the field of Material Science. Specific knowledge on polymer synthesis, 3D printing (mainly VAT polymerization technology), characterisation of thermosets will be appreciated. Candidates must be fluent in English with writing / communication skills. The annual salary is between approx. 25 – 30 k€. The candidate would stay at Douai and would spend some short periods in Brest.

The CERI MP offers two distinct scientific seminars per month, aimed at enhancing participants' scientific expertise. The PhD student will join a young and dynamic team engaged in various research areas, including (bio)plastic formulation, transformation via multiple processes such as 3D printing, functional device fabrication and recycling. Furthermore, sports activities and after-work events are organized to foster team cohesion.

### **BRIEF:**

The development of autonomous or self-powered *IoT* sensors represents a key challenge and energy harvesting technologies are attractive to convert mechanical, thermal, radiofrequency, solar, magnetic or fluid flow energy into electrical energy. A next-generation of functional materials and low cost devices with a better balance between environmental footprints, materials / processing costs and technical performances is required for a large-scale deployment of energy harvesters. In this context, IMTNE & IMTA are involved for several years into

various research projects (for example, BIOHARV & THERMOHARV INTERREG projects & GENEPI ANR project, OPAL, SAFIRS) dealing with sustainable vibrational and thermal gradients energy harvesters.

Following these initiatives, a collaboration between IMT NE and IMTA has been initiated to develop radiofrequency harvesters based on three-dimensional (3D) shaped rectennas. However, the limitations of current technologies hinder the development of 3D antennas that offer higher gain and improved omnidirectionality compared to flat antennas. To address this challenge, the project proposes an innovative combination of additive manufacturing and screen printing. A shape-memory polymer substrate will be printed in a flattened form, screen-printed with conductive inks, and then redeployed to regain its initial 3D shape. The objective is to produce high-performance, cost-effective devices with complex geometries. Preliminary studies have demonstrated the feasibility of this concept, yielding promising results while also highlighting areas for improvement, such as dimensional control, ink adhesion, and 3D device performance.

The PhD candidate will be involved in the following scientific and technological missions:

- Understanding the relation between the process parameters (VAT polymerization 3D printing) and the properties of the 3D polymer substrate (dimension and geometry accuracy, surface roughness, crosslinking rate, etc.).
- Evaluate the correlation between the polymer structure and recovery rate and kinetics as function the applied stimuli.
- Allow significant deformation of the polymer substrate without degrading the RF performance of the conductive tracks.
- Establish a correlation between the design of the deposited conductor tracks, the geometry of the polymer substrate and overall RF performance.

Valorization activities are expected into national / international events and teaching opportunities at L2 to M2 levels will be also possible in the frame of the IMT NE & IMTA formations.

#### **REQUIRED PROFILE :**

<b>Skills</b>	<b>Knowledge</b>
Polymer synthesis, VAT polymerization, Characterizations of polymers (DSC, FTIR, rheology, crosslinking rate determinations, etc), oral & written communication skills. Process, screen printing, Ink jet Printing.	Physics and chemistry of thermoplastic and thermosets polymers, Processing technologies of polymers, shape memory polymers. Electromagnetism basis

#### **CONDITIONS :**

The job is to be filled as to 01/09/2025 for a period of 36 month (temporary contract).

#### **INFORMATION AND APPLICATION METHODS :**

For any information on the missions, please contact:

**Dr. CHARLON Sébastien**, [sebastien.charlon@imt-nord-europe.fr](mailto:sebastien.charlon@imt-nord-europe.fr)

**Dr KHALDI Alexandre**, [alexandre.khaldi@imt-atlantique.fr](mailto:alexandre.khaldi@imt-atlantique.fr)

For any administrative information, please contact the Human Resources Department: [jobs@imt-nord-europe.fr](mailto:jobs@imt-nord-europe.fr)

To apply, please connect to our recruitment platform via the following link: <https://institutminestelecom.recruitee.com/o/phd-position-fabrication-of-3d-antennas-for-radio-frequency-energy-harvesting-in-temporary-contract-at-imt-nord-europe>

**DEADLINE DATE FOR SUBMISSIONS:** 01/05/2025