Title of the thesis	Magnesium based Nano Composites for Orthopedic Applications
Acronym	MAGNACOM
Reference number	009

Hosting institution	**Employer**
Université de Lille Website: https://www.univ-lille.fr/home/	Université de Lille Website: https://www.univ-lille.fr/home/
Hosting research unit 1	**Hosting research unit 2**
Name: Unité Matériaux Et Transformations Acronym: UMET Identification number: UMR 8207 Address: Université de Lille Cité scientifique Bâtiment C6 59655 Villeneuve d'Ascq Website: http://umet.univ-lille1.fr/	Name: Médicaments et Biomatériaux à Libération Contrôlée: Mécanismes et Optimisation Identification number: U1008 Address: Faculté des Sciences Pharmaceutiques et Biologiques - 3 rue du professeur Laguesse 59006 Lille Website: http://u1008.univ-lille2.fr/home.html
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Thesis information	
Keywords	bio-degradability, bio-wettability, bio-implants, magnesium, orthopedic applications
Abstract	Bone is a porous bio-nanocomposite made up of a collagen fiber matrix and hydroxyapatite crystals (of size 5 nm x 20 nm x 40 nm). Medical innovation and an aging demographic are two key factors behind the growth in the orthopedic implant sector. A rising elderly population is resulting in a stronger demand for procedures such as hip and knee replacements. It is estimated that the global orthopedic implant market will grow at a compounded annual gross rate of 5.9%. Globally, the use of medical devices has hit an all-time high, with the medical device industry currently valued at $370 billion and strong growth predictions through to 2025. Orthopedic implants can be classified as permanent implants and temporary implants. Revision surgeries are often carried out to remove the implants after they heal the part replaced. This causes severe mental trauma and is often expensive to be borne by the patient. Hence, the need for bio-dissolvable implants are of the prime necessity to overcome these issues. Presently, stainless steel, titanium and titanium alloys are the commonly used implant materials for orthopedic applications. Stainless steel has a high risk of nickel toxicity leading to allergic reactions within human body. Both non-biodegradable titanium and stainless-steel implants require revision surgery to remove the implants after the wound healing process. Further, titanium does not

	bond with bone leading to implant loosening and allergic responses. Stress shielding effects arising due to the mismatch in the Young's modulus values between the bone and the implant pose a major threat contributing to revision surgery. Magnesium has considerable advantages over other non-biodegradable metals with lower Young's modulus (41–45 GPa), which is closer to that of natural bone (3 to 20 GPa). The present proposal aims at the following 2 challenges in the "Development of bio-degradable nanocomposites of Mg-Metal Oxide based materials in both dense and porous". 1. Dense and porous Mg-MO materials for the bio implantation using Induction Melting Facility at IUT Lille. 2. Bottleneck – Increasing the bio-wettability and controlling the degradation rate of Mg composites to augment their applications. The proposed hypothesis is to develop porous and dense Mg nanocomposites containing biocompatible nanoparticulate metal oxide and different forms of calcium phosphates using energy efficient induction melting and sintering and characterized for mechanical, corrosion, cytotoxicity, in vitro and in vivo degradation behaviour. This project brings together excellence of two lead PIs and a consortium of competent laboratories for a common goal. 1. University of Lille (Principal investigator in France- UMET) 2. INSERM - ULille 3. KU Leuven – Belgium
Expected profile of the candidate	Ideal candidate should have strong physical metallurgy orientation along with the experience in the alloy design and the processing of the materials. Experience in material characterisation and electrochemistry exposure is a welcome point. Masters in Metallurgical and materials engineering with an exposure to international research, publication and demonstrated report writing skills. Earlier work on the bio-materials from the metallic materials and invitro-invivo experiments would form an added point.
Application procedure	The application procedure is detailed on the European programme PEARL website www.pearl-phd-lille.eu. The funding is managed by the I-SITE ULNE foundation which is a partnership foundation between the University of Lille, Engineering schools, research organisms, the Institut Pasteur de Lille and the University hospital. The application file will have to be submitted before April 15, 2020 (10h Paris Time) and emailed to the following address : international@isite-ulne.fr.
Net salary and Lump Sum	A net salary of about €1,600 + €530 per month to cover mobility, travel and family costs.