The European Training Network "MgSafe" is offering in total

15 PhD positions

in the area of magnesium implant imaging.

The EU-funded **MSCA-ITN 'MgSafe'** investigates a novel combination of imaging technologies for biodegradable magnesium implants in order to promote patient safety.

The PhD candidates will quantify the physical impact and suitability of a variety of modalities on Mg implants. Highly sophisticated imaging techniques (nano and µCT, MRT, PET, USPA, IR) will be developed beyond the forefront of medical device production. This will be done *in vivo* and with *in situ* labelling options to deliver non-invasively data on different time and length scales. The body reaction and material behaviour will be investigated during Mg degradation with a precision and plethora of details, which is currently not available.

We are looking for highly motivated candidates for the following **PhD projects** (please find below a more detailed project description):

P1: *In vivo* characterisation of designated Mg materials (pins and wires) by µCT and fluorescence imaging in rats.
Medical University of Graz, Department of Orthopedics and Traumatology, Graz, Austria (Prof. A.-M. Weinberg)

P2: Large animal *in vivo* characterisation of designated full size Mg implants (K-Wires, screws) by clinical CT in a juvenile sheep model.
Medical University of Graz, Department of Orthopedics and Traumatology, Austria (Prof. A.-M. Weinberg) in cooperation with Graz University of Technology, Institute of Biomechanics, Graz, Austria (Prof. G. A. Holzapfel)

P3: Histological validation of advanced bone implant imaging techniques.
Department of Biomaterials, Institute for Clinical Dentistry, University of Oslo, Norway (Prof. H.J. Haugen)

P4: Molecular and structural analyses during bone healing and soft-tissue inflammation.
Department of Biomaterials, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden (Prof. P. Thomsen)

P5: MRI development for Mg implants to study inflammation.
Hannover Medical School, Institute for Laboratory Animal Science, Combinatorial Imaging Facility, CiF, Hannover, Germany (Dr. M. Meier)

P6: Multimodal imaging of bone regeneration and remodelling after implantation of degradable Mg-based devices in experimental animal models.
National Research Council (CNR) Institute of Clinical Physiology, Pisa, Italy (Prof. L. Menichetti)

P7: Biochemical and biohumoral studies of bone regeneration and remodelling after implantation.
National Research Council (CNR) Institute of Clinical Physiology, Pisa, Italy (Prof. L. Menichetti)

P8: *In vivo* monitoring of the body reaction to the implant by using a novel optical probe and near infrared spectroscopy.

Oslo Metropolitan University, Faculty of Technology, Art and Design, Department of Mechanical, Electrical and Chemical Engineering, Oslo, Norway (Dr. Mirtaheri)

P9: Characterisation of corrosion layer structure and composition in explants.
Biomaterials Group, Materials Design Division, Faculty of Materials Science and Engineering, Warsaw University of Technology, Warsaw, Poland (Prof. W. Swieszkowski)

P10: Structural characterisation of explants by synchrotron radiation: differential phase contrast (DPC) µ and nano tomography for investigation of Mg implant tissue interface.
Helmholtz-Zentrum Geesthacht, Institute for Materials Research, Outstation at DESY, Hamburg, Germany (Prof.R. Willumeit-Römer)

P11: Structural characterisation of explants by synchrotron radiation: Bone remodelling at the implant-bone interface, SAXS investigations.
Helmholtz-Zentrum Geesthacht, Institute for Materials Research, Outstation at DESY, Hamburg, Germany (Prof.R. Willumeit-Römer)

P12: Software development for management and visualisation of multimodal data.
SCANCO Medical AG, Bruettisellen, Switzerland (Dr. V. Stadelmann)

P13: En route to the clinic: MR safety - MR antenna design tailored for Mg alloy implants.
MRI.TOOLS GmbH, Robert-Roessle Strasse 10, 13125 Berlin, Germany (Prof. T. Niendorf)

P14: En route to the clinic: MR safety - influence of Mg implants on MR signal.
Syntellix AG and MHH, Research and Development, Hannover, Germany (Dr. J.-M-Seitz)

P15: High-resolution ultrasound and photoacoustic (USPA) imaging for human application.
Fujifilm Visualsonics, Amsterdam, the Netherlands (Dr. J. Jose)

Our offer:

- Excellent job opportunities in attractive and well-equipped research groups (e.g. nano and µCT, MRT, PET, USPA, IR, microscopy, cell culture and corrosion laboratories)
- Intense exchange with researchers located in eight European countries
- Comprehensive academic support program including subject-specific courses, soft skill training, research stays abroad, individual career coaching
- 3-year employment contract, salaries according to the EU MSCA-ITN regulations

Your general qualifications (for the specific requirements of the 15 positions we refer to the projects details below):

- Research-based master's degree or equivalent (e.g. diploma) in a subject related to the respective position
- Excellent command of English
- Pro-active attitude, good communication skills and ability to work effectively in an interdisciplinary international team
- Flexible, creative, self-organised and able to work independently on multiple tasks
- Experience in publishing
- Motivation to participate in the projects training program

Mobility requirements of MSCA-ITN European Training Networks:

Applicants need to be **Early-Stage Researchers**. They must, at the date of recruitment, be in the first four years (full-time equivalent research experience) of their research careers (= after acquiring MSc degree or similar) and have not been awarded a doctoral degree yet.

Researchers can be of **any nationality**. They are required to undertake physical, **transnational mobility** (i.e. move from one country to another) when taking up their appointment. **Mobility rule:** researchers must not have resided or carried out their main activity (work, studies, etc.) in the country of the recruiting beneficiary for more than 12 months in the 3 years immediately before the recruitment date.

Starting from **April 1st 2019**, the positions will be awarded for three years.

How to apply:

Please send your application in English indicating **job offer code no. 2018/WB 5** and **which position you are interested** in by email preferably in one pdf file not exceeding 10 MB to application.mgsafe@hzg.de. Please DO NOT send applications via email to individual PIs or organisations. Such emails will not be considered.

Make sure that your application includes:

- a CV which gives an overview of the academic/education history, including a list of courses/exams and grades, the exact award date (day/month/year) of the degree with original transcripts of Bachelor and Master University Degree (or similar) as well as copy of valid identity documents,
- a list of your publications,
- a list of skills you acquired during the courses attended at university,
- a documentation of special skills suitable for the position you apply for,
- a documentation of your excellent English skills (e.g. TOEFL, IELTS, CAE or CPE with minimum scores of: TOEFL: 600 (paper-based test), 92 (Internet-based test), IELTS: 6.5 with no section lower than 5.5, or equivalent),
- a copy or half-page summary of master/diploma thesis and
- a letter of motivation (up to 2 pages) which states your research experience and interests and a concrete project plan, which explains how you envisage your work in the project,
- names and contact information of at least two academic referees who could write a letter of recommendation.

Deadline for applications: 31.10.2018

Details of the 15 PhD positions in MgSafe:

P1: *In vivo* characterisation of designated Mg materials (pins and wires) by µCT and fluorescence imaging in rats.

Project description:

The research topic is to establish and combine imaging techniques to evaluate magnesium-based implants in juvenile and adult rats. The applicant will surgically implant the material into rat femura. Additionally, he/she will (i) quantify implant degradation and bone response in vivo together with molecular activities of osteoblast, osteoclast and inflammatory cells; (ii) histologically correlate with fluorescence signal of osteoblast, osteoclast and inflammatory response; (iii) determine the metabolical phenotype of bone and surrounding tissue by ex vivo NMR; (iv) deliver data, explants and tissue to network partners.

Specific Requirements:

The applicant holds a master's degree in biochemistry, biology, or related life science areas. He/she is able to apply standard methods and willingness to learn novel techniques is of utmost importance and is experienced in state-of-the-art techniques. Expertise in animal handling, biomaterials or orthopaedics is advantageous.

Place of work:

Medical University of Graz, Department of Orthopedics and Traumatology, Graz, Austria (Prof. Annelie-Martina Weinberg)

Medical University Graz, Prof. A.-M. Weinberg

P2: Large animal *in vivo* characterisation of designated full size Mg implants (K-Wires, screws) by clinical CT in a juvenile sheep model.

Project description:

The research topic is the quantitative and qualitative evaluation of Mg-based implants in growing sheep. The applicant will surgically implant the material into the tibiae of juvenile sheep. Additionally, he/she will (i) quantitatively and qualitatively analyse the implantation site with regard to clinically relevant aspects; (ii) determine the suitable, clinically relevant implant shape and Mg amount with respect to possible local side effects (osteolysis, necrosis, pseudoarthrosis); (iii) analyse the degradation behaviour (volume and surface changes) and gas evolution in sheep; (iv) evaluate the related biomechanical properties of the Mg-based implants with regard to yield strength, elastic modulus, ultimate tensile strength for the specific application and comparison to a standard implant.

Specific Requirements:

The applicant holds a master's degree in (biomedical) engineering, or related life science areas, such as medicine. The ability to apply standard methods and willingness to learn novel techniques is of utmost importance.
Experience in state-of-the-art techniques is required. Expertise in animal handling, imaging techniques, such as clinical CT or microCT, in the mechanics of up-to-date biomedical materials or orthopaedics is advantageous.

Place of work:
Medical University of Graz, Department of Orthopedics and Traumatology, Austria (Prof. Annelie-Martina Weinberg) in cooperation with Graz University of Technology, Institute of Biomechanics, Graz, Austria (Prof. Gerhard A. Holzapfel)

Medical University Graz, Prof. A.-M. Weinberg

Graz University of Technology, Prof. G.A. Holzapfel

P3: Histological validation of advanced bone implant imaging techniques.

Project description:
The research topic is to evaluate the biological performance of implants made of magnesium alloys in vivo and in vitro. The applicant has to verify correlation between imaging techniques (microCT, PET, MRI) with immunohistology and histological evidence in vivo. This will involve techniques like embedding of hard tissue, histomorphometry and immunohistochemistry. He/she is able to apply standard methods to characterise cell type, evaluate cell and tissue morphology, and tissue regeneration.

Specific Requirements:
The applicant holds a master's degree in medicine, biochemistry, biology, or related areas. Experience in cell culture work and/or histology/immunohistology (ideally in the area of bone and bone remodelling) is desirable. Expertise in imaging (e.g. microscopy, microCT) is requested.

Place of work:
Department of Biomaterials, Institute for Clinical Dentistry, University of Oslo, Norway (Prof. Dr. H.J. Haugen)

University of Oslo, Dept. of Biomaterials

P4: Molecular and structural analyses during bone healing and soft-tissue inflammation.

Project description:
The research topic focuses on the biological reactions to biodegradable Mg-based implants and aims at evaluation of the cellular and molecular events during healing and implant degradation. Furthermore, the structural evolution during healing will be studied using a range of microscopy and spectroscopy techniques in order to gain an increased understanding of how degradable materials influence the structural parameters of bone as compared to healing around permanent materials such as titanium. The knowledge generated in this project is of fundamental importance for the translation to safe clinical use.

The specific research questions addressed during the project are:
• How does the implant degradation affect the cellular and molecular events in the bone-implant interface?
• How do these events relate to the structure and function of the bone implant interface with regard to composition and mechanical properties?

The project involves state-of-the-art, cellular and molecular techniques and a broad range of microscopy techniques to evaluate the different hierarchical levels of

osseointegration, from molecular events and nanoscale interactions to macroscale function. Further, the project includes experimental *in vivo* models.

Specific Requirements:

The applicant holds a master's degree in materials science, dentistry, medicine, or related areas.

Place of work:

Department of Biomaterials, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden (Prof. P. Thomsen)

University of Gothenburg, Department of Biomaterials

P5: MRI development for Mg implants to study inflammation.

Project description:

The research topic is the longitudinal 3D physiological measurements in rats by MRT/MRS, multimodal approaches MRT/USPA and FMT/µCT. Development and optimisation of imaging procedures. Imaging of Mg implant degradation and monitoring the functional changes of tissue parameters (inflammation/angiogenesis/oxygenation). The applicant will be involved in surgical procedures on animals, will produce and analyse complex data with respect to the property profile of materials.

Specific Requirements:

The applicant holds a master's degree in veterinary or biomedical science, or related areas. He/she is willing to be involved in animal research. Experience in at least one of the areas of imaging technologies, small animal surgery, laboratory animal science, processing and analysis of matrix data (ideally in the area of magnetic resonance spectroscopy) is required. Expertise in animal handling, basic statistics, basics of imaging physics and imaging technologies is requested.

Place of work:

Hannover Medical School, Institute for Laboratory Animal Science, Combinatorial Imaging Facility, CiF, Hannover, Germany (Dr. M. Meier)

Hannover Medical School

P6: Multimodal imaging of bone regeneration and remodelling after implantation of degradable Mg-based devices in experimental animal models.

Project description:

The research topic is multimodal imaging of bone regeneration and bone remodelling after implantation of a degradable Mg-based device in experimental animal models. The specific objectives will be: (1) Study of the dynamic regulation of bone regeneration and remodelling. (2) Validation of the probes/target combination, both in vitro and in vivo, following a multimodal approach by small animal Positron Emission Tomography (PET), High frequency Ultrasound (HF-US), and photoacoustic imaging (PAI). (3) Integration of bone metabolism and homeostasis by morphometric measurements. (4) Development of new preclinical imaging strategies for translation in a clinical setting.

Specific Requirements:
The applicant holds a master's degree in chemistry, pharmaceutical chemistry, pharmacy, or physics and is interested in multi/ interdisciplinary research. Experience with tracer chemistry and physics is required.

Place of work:
National Research Council (CNR) Institute of Clinical Physiology, Pisa, Italy (Prof. L. Menichetti)

National Research Council (CNR) Institute of Clinical Physiology

P7: Biochemical and biohumoral studies of bone regeneration and remodelling after implantation.

Project description:
The research topic is to assess circulating biomarkers in order to predict and/or monitor efficacy/toxicity of the degradable implant through a multi-marker technology. This will lead to the development of an integrated approach for biomarker development in the field of Mg-implants. This approach shall be integrated with multimodal and molecular imaging of bone regeneration and remodelling after implantation of degradable Mg-based devices. The specific goals will be: (1) in vitro validation studies with specific probes labelling integrin αvβ3 to detect angiogenesis in vivo; (2) validation of the probes/target combination with state-of-art technologies, both in vitro and in vivo, following a multimodal approach by small animal Positron Emission Tomography (PET), high resolution ultrasound (HR-US) and photoacoustic imaging (PAI), (3) integration of biohumoral and biochemical information with image-derived parameters of bone metabolism.

Specific Requirements:
The applicant holds a master's degree in biological chemistry, biology, pharmaceutical chemistry, pharmacy, or medicine and is interested in multi/ interdisciplinary research. Experiences in the fields of (bone) tissue remodelling and inflammation biomarkers are advantageous.

Place of work:
National Research Council (CNR) Institute of Clinical Physiology, Pisa, Italy (Prof. L. Menichetti)

National Research Council (CNR) Institute of Clinical Physiology

P8: *In vivo* monitoring of the body reaction to the implant by using a novel optical probe and near infrared spectroscopy.

Project description:
The research topic is focusing on the development and optimisation of an optical near infrared probe for the measurement and analysis of absorption spectra and local perfusion at the implant-tissue interface. The applicant will develop an optical probe for measurements of physiological parameters such as oxygenation, pH and related physiological parameters to compare with morphological changes at the implant's interface. Standard methods for optical measurement techniques and fibre optical probes will be applied for the design of the probe. In addition, multivariate calibration and Statistical Parameter Mapping (SPM) methods are the main tools in this project.

Specific Requirements:

The applicant holds a master's degree in electronics, biomedical engineering, or relevant fields with 120ECTS or equivalent level that is approved by NOKUT (the Norwegian Agency for Quality Assurance in Education). The candidate has average grades of A (best grade) or B within a scale of A-E passing grades in his/her master degree. Furthermore, expertise in the optical instrumentation, calibration and analysis of optical spectroscopy methods, validation of measurements is desired. Experience in near infrared spectroscopy, optical characterisation in tissue and analysis of optical data is requested. Experience in developing optical and medical instruments and sensors, and programming skills (e.g. Matlab) will be beneficial.

Place of work:

Oslo Metropolitan University, Faculty of Technology, Art and Design, Department of Mechanical, Electrical and Chemical Engineering, Oslo, Norway (Dr. Mirtaheri)

Oslo Metropolitan University, Prof. P. Mirtaheri

P9: Characterisation of corrosion layer structure and composition in explants.

Project description:

The research topic is the characterisation of the corrosion layer structure and composition in explants. The applicant will characterise surface and interface properties as well as the topography of Mg-explants after in vivo degradation. He/she will operate equipment like SEM, TEM, EDX and AFM including sample preparation. Additional knowledge in the area of biomaterials is required.

Specific Requirements:

The applicant holds a master's degree in materials science, chemistry, or related area with specific focus on biomaterials. Experience in materials surface characterisation of light metals and their interaction with biological cells or tissues is required. Basic expertise in operation of Scanning Electron Microscopy and Atomic Force Microscopy is mandatory. The applicant will work with explants and is familiar with the preparation of biological samples.

Place of work:

Biomaterials Group, Materials Design Division, Faculty of Materials Science and Engineering, Warsaw University of Technology, Warsaw, Poland

Supervisor: Prof. W. Swieszkowski

Warsaw University of Technology, Biomaterials Group

P10: Structural characterisation of explants by synchrotron radiation: differential phase contrast (DPC) µ and nano tomography for investigation of Mg implant tissue interface.

Project description:

The research topic is imaging and characterisation of Mg implants in native tissue environments. This will be investigated by applying high-energy differential phase contrast (DPC) tomographic imaging, and create multimodal image data sets integrating phase, attenuation and dark field CT-data. The project will focus on the optimisation of SR tomography contrast techniques and data analysis protocols for the characterisation of metallic implant tissue interfaces and the implementation of

approaches for multimodal data analysis e.g. including Deep / Machine Learning approaches.

Specific Requirements:
The applicant holds a master's or diploma degree in physics, or related areas. Experience in the field of x-ray imaging and image processing, including processing/scripting skills to develop custom data analysis pipelines, is required. Expertise in instrumentation and setup development is highly appreciated.

Place of work:
HZG-outstation at DESY, Hamburg, of the Helmholtz-Zentrum Geesthacht, Institute for Materials Research, Germany (Prof. R. Willumeit-Römer)

Helmholtz-Zentrum Geesthacht, Metallic Biomaterials

P11: Structural characterisation of explants by synchrotron radiation: Bone remodelling at the implant-bone interface, SAXS investigations.

Project description:
The aim of the research topic is the investigation of the bone implant interface by use of high-resolution x-ray scattering. The applicant will perform diffraction and small angle x-ray scattering experiments with x-ray beams of the size of 250 nm to elucidate differences in bone structure close to the implant interface and in distant bone and to investigate if corrosion products (e.g. hydroxyapatite) are ordered in a bone like fashion. This is complemented by histological and spectroscopic techniques to correlate structure and function of degradable implants.

Specific Requirements:
The applicant holds a master's degree in physics, mathematics, or related areas. Experience in x-ray scattering, ideally x-ray diffraction or small angle scattering, and/or programming is required. Knowledge in the field of machine learning would be beneficial.

Place of work:
HZG- outstation at DESY, Hamburg, of the Helmholtz-Zentrum Geesthacht, Institute for Materials Research, Germany (Prof. R. Willumeit-Römer)

Helmholtz-Zentrum Geesthacht, Metallic Biomaterials

P12: Software development for management and visualisation of multimodal data.

Project description:
The research topic is the software development for management and visualisation of multimodal data, development of visualisation methods depicting the evolution of magnesium implants using volume-rendering algorithms of any pre-registered multimodal volumes. It also implies the comparison with low-resolution 3D data for the understanding of the processes involved and the development of new contrast imaging techniques for human applications.

Specific Requirements:
The applicant holds a master's degree in computer science or mathematics, materials science, or related areas. Experience in algorithm developments & image processing - ideally in a biomedical field – is required.

Place of work:
SCANCO Medical AG, Bruettisellen, Switzerland (Dr. V. Stadelmann)

SCANCO Medical AG

P13: *En route* to the clinic: MR safety - MR antenna design tailored for Mg alloy implants.

Project description:
The research topic is the development and optimisation of Magnetic Resonance Imaging (MRI) techniques for degradable implant applications. A Mg-based conductive implant in the patient's body interacts with the radiofrequency (RF) field of an MR scanner. This may result in local RF induced heating in the tissue, which might constitute a patient safety hazard. For going en route to clinical applications of Mg implants, it is essential to understand and control the interaction of passive, conducting Mg-based implants with RF fields. Here, our research will focus on (1) electromagnetic field (EMF) simulations to detail electric fields and local RF power deposition in humans for frequencies accommodating today's clinical and research MR scanners, (2) E-field measurements to benchmark the outcome of the computational modelling with experiments, (3) thermal numerical simulations and its verification in RF heating experiments, (4) development of an implant friendly radiofrequency antenna using multi-channel transmission MR, (5) development of RF shimming algorithms that use the degrees of freedom of multi-channel transmission to generate reduced RF field zones or "null mode" excitations that induce minimal RF current in Mg implants, thereby decreasing the RF heating hazard, while still allowing imaging of the surrounding volume.

Specific Requirements:
The position would be well suited for applicants with an open minded interest in medical imaging, expertise in numerical simulations or with a strong hardware background, with strong initiative and excellent communication skills. The candidate holds a master's degree (Master of Science or equivalent) in physics, electrical engineering, biomedical engineering, computer science, or a related discipline. Hardware development and/or signal/image processing experience is beneficial.

Place of work:
MRI.TOOLS GmbH, Robert-Roessle Strasse 10, 13125 Berlin, Germany (Prof. T. Niendorf)

Interested candidates should please contact niendorf@mritools.de for more details.

MRI.TOOLS GmbH

P14: En route to the clinic: MR safety - influence of Mg implants on MR signal.

Project description:
The research topic is the determination of the impact of radiofrequency on heating of Mg-implants. The applicant will develop test plans to study the influence of implant degradation on the MR signal, including the determination of the implant's state of degradation. For this purpose, implants in different in vivo and in vitro degradation states will be scanned with different parameter sets. Besides minimising heating, dislocation and antennae effects that potentially occur during MR-scanning, an

optimised visualisation of the degradation zone shall be achieved. Following this, the translation of the animal studies' results into human applications will be tackled.

Specific Requirements:
The applicant holds a master's degree or diploma in materials science, (imaging) physics, or related areas. Expertise in the field of material characterisation by x-ray imaging and MR-imaging is required. Knowledge of MR parameters and the interaction of MR signals with (light) metals is advantageous. The applicant should be able to design and support in vitro and in vivo studies.

Place of work:
Syntellix AG and MHH, Research and Development, Hannover, Germany (F. Zaage, Dr. J.-M. Seitz)

Syntellix AG

P15: High-resolution ultrasound and photoacoustic (USPA) imaging for human application.

Project description:
The research topic is to work on the design of the photoacoustic imaging system. The current approach will be optimised for small animal imaging (mice/rat). The applicant will modify the transducer and the working interface to meet the needs of patient monitoring. This non-invasive imaging approach is ideal for the long-term follow up of implant degradation. The results will be validated with other imaging approaches.

Specific Requirements:
The applicant holds a master's degree in physics, biomedical engineering, biology, or related areas. He/she has expertise in preclinical or clinical imaging (e.g. ultrasound, photoacoustics, MRI, CT or similar). Ideally, the candidate holds a FELASA certificate.

Place of work:
Fujifilm Visualsonics, Amsterdam, the Netherlands (Dr. J. Jose)

Fujifilm Visualsonics

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