Job title	**Elaboration of functional regenerators with very high loaded MagnetoCaloric (MC) powders by different polymer processing and metallurgy processes (PhD student 1)**
Ref	2018-06-COMPOMAG1
Job type (PhD, Post-doc, Engineer)	Ph.D.
Contract duration (months)	36 months
Qualifications (Master degree, PhD…)	Master degree
Job hours (full time/ part time)	Full time
Employer	UBFC – Université de Franche-Comté
Host Laboratory	Institut FEMTO-ST
URL Host Laboratory	www.femto-st.fr
Address Host Laboratory	15b avenue des Montboucons, 25030 Besançon, France
Job description	Introduction : Magnetic refrigeration is a new research domain appeared almost twenty years ago that requires multidisciplinary knowledge in many domains such as physics (magnetism, thermodynamics, fluid mechanics, heat transfers), materials and forming processes. The COMPOMAG project is focused on the manufacturing of thermoplastic highly loaded in MagnetoCaloric (MC) powder in order to obtain MC composite regenerators with specific microstructure on its surface. This structuring at microscopic level (i.e. geometric details at the surface) is required to facilitate the stacking up of the MC regenerator and to enhance the heat transfer and mixing in the fluid boundary layer simultaneously. Moreover, in order to improve dimensional accuracy, the use of finer granulometries of the powders is also required to explore and push the current limits of forming processes and consequently to increase the MC properties. This work will enable the development of innovative nanocomposites with specific functional properties to implement new MC devices that can be

	used at the end of the project for thermodynamic applications in industrial or domestic cooling and heat pumping. By optimizing the design of the heart of MC machine (performing micro-structured regenerator), it is about allowing the emergence of a low cost, environment-friendly industrial refrigeration technology sector, whether in the choice of materials (abundance, economy of rare earth) or in the choice of heat transfer fluids (no greenhouse gases, no ozone depleting power) or in congestion (high power density). In this project, the forming process of materials, the magnetic-dependant thermo-physical characterization of powders and developed components, the optimization based on multiphysics - multiscale analytical and numerical models will be also studied in details. The **COMPOMAG** project include two PhD students in three different departments of FEMTO-ST located at Besançon and Belfort cities in France. The departements are Applied Mechanics, Micro/Nano Sciences and Systems and Energy. The consortium includes also two companies. The first PhD student, defined as PhD student 1, will develop and optimize functional micro- and nano- composites and new innovative shaped regenerators produced in the final stage of the **COMPOMAG** project and dedicated to validate the proofs of concept. The functional physic properties will be also quantified by different characterization: in situ tensile tests, X ray tomography, magnetometry, … Schedule tasks (PhD students 1 & 2) : The work of these two PhD students will include the following major steps: - Elaboration and forming process of the magnetocaloric regenerators (PhD student 1), - Mechanical and thermophysical characterizations of materials and regenerators (PhD students 1 & 2). The specific multiphysic characterizations on test samples will be developed (PhD student 2), - Identification of the constitutive laws (PhD student 1), developement of multi-physics behavior models and identification of theirs parameters (PhD student 2), - Study of the different multiphysics couplings and of the treatment strategy of them (without coupling, iterative approaches or fully coupled) (PhD students 1 & 2), - Simulations of the nanocomposite forming process (PhD student 1) and of the functional properties (magnetic, magnetocaloric… to be defined) of regenerators with different multiphysics approaches (PhD student 2), - Optimization of the nanocomposite elaboration and forming process (PhD student 1), and of the functional properties (magnetic, magnetocaloric… to be defined) and geometry of regenerators (i.e. dimensions and geometry of its surface) (PhD student 2).
Supervisor(s)	• Thierry BARRIERE (Professor, UFC; Institut FEMTO-ST/Applied mechanics/Besancon), supervisor • Laurent HIRSINGER (CR, CNRS; Institut FEMTO-ST/MN2S/Besancon), co-supervisor
Candidate profile	The candidate will be employed by FEMTO-ST and will benefit from the skills and experiences of the laboratory in the fields of micro-mechanics, polymer forming, material processing, material characterizations and numerical simulations. She/he will be involved for the elaboration of

	magnetocaloric regenerators from powders forming to thermophysical characterization and identification of physical behavior forming processes and functional magnetic and magnetocaloric properties. Skills in mechanic and multiphysics characterization, polymer and powder forming process is required. The candidate should be qualify in this fields and be motivated by microtechnology and experiments in the set up to characterize the set of magnetocaloric regenerators devices. A thorough knowledge of English and/or French is required. Experience in programming with Matlab and/or COMSOL, material forming processes and thermophysical characterizations are favourable with an interdisciplinary approach.
Keywords	Elaboration / Forming process / Polymer / Nanocomposite / Mechanics (fluids & solids) / Computing / Magnetism
Application deadline	30 June 2018
Application	Please send the following documents (all in one PDF file) by e-mail to job-application@ubfc.fr: 1) For EU candidates: Copy of your national ID card or of your passport page where your photo is printed. For non-EU candidates: Copy of your passport page where your photo is printed. 2) Curriculum Vitae (1 page). 3) Letter of motivation relatively to the position (1 page). 4) Copy of your Master degree if already available. 5) Copy of your final marks and ranks. 6) Coordinates of reference persons (maximum 3, at least your master thesis supervisor): Title, Name, Organization, e-mail. If you have questions regarding the application, please contact the supervisors. Thierry BARRIERE (Professor, UFC; Institut FEMTO-ST/Applied mechanics/Besancon), thierry.barriere@univ-fomte.fr Laurent HIRSINGER (CR, CNRS; Institut FEMTO-ST/MN2S/Besancon), laurent.hirsingher@univ-fcomte.fr