Institut des Molécules et Matériaux du Mans – IMMM - UMR CNRS 6283

Institut des Molécules et Matériaux du Mans UMR 6283 CNRS – Le Mans Université
Avenue Olivier Messiaen
72085 - LE MANS cedex 9

Affaire suivie par L. FONTAINE
Directeur
☎: 02 43 83 33 25
Laurent.fontaine@univ-lemans.fr

Le Mans, 3 October 2021

As Director of the Institute of Molecules and Materials of Le Mans (IMMM UMR 6283 CNRS – Le Mans University see http://immm.univ-lemans.fr/fr/index.html), I am sending you this letter in order to distribute it to a large panel of laboratories linked to the international Mössbauer community, on the basis of the recommendation of Jean-Marc Greneche. Indeed, as you probably know, Jean-Marc, who was a member of the IBAME board, will retire at the end of October 2021 but will continue scientific activities as CNRS Emeritus Research Director. The Research Institute of Le Mans is thus looking for excellent young and dynamic candidates to maintain and develop scientific activity as described below in a 5-years post-doctoral framework with the prospect of recruiting for a permanent position.

Please send your proposals at:
laurent.fontaine@univ-lemans.fr and/or jean-marc.greneche@univ-lemans.fr

Laurent Fontaine,
Director of IMMM

The proposal made by the CNRS Institute of Chemistry to our laboratory (IMMM), and supported by Le Mans University, is to host a CNRS post-doc for 5 years on a research project mainly focused on Mössbauer spectrometry applied to solid state physics. The objective is to maintain research activities in this field, which is less and less represented at the national level, within the framework of the retirement of Jean-Marc GRENECHE, Director of Research at CNRS, scheduled for the end of October 2021.

Research activities involving the use of ^{57}Fe Mössbauer spectrometry in Le Mans are mainly developed by J.M. GRENECHE (h index ≥ 58) with the NanoMagnetism and Modeling (NMM) group of IMMM (1 CNRS research director, 3 Professors and 3 Assistant Professors) within the "Physics of Confined Systems" thematic and are highly visible, both nationally and internationally. With a remarkable production of more than fifteen articles per year in the best high impact journals, this work has led to a recognition resulting in numerous invitations in international conferences, training courses and networks, as well as multiple national and international collaborations.

The research work of the NMM group concerns mainly different types of magnetic (nano)materials (nanocrystalline alloys, nanoparticles, nanocomposites, nanostructured powders, environmental materials) with the aim of understanding their intrinsic magnetic properties including surface and/or interface phenomena, anisotropies, exchange bias, magnetic frustration, etc. A first experimental approach on these materials, most of them elaborated by chemists possessing a great expertise in the synthesis of nanostructures in the framework of local, regional, national and international collaborations, is based on ^{57}Fe Mössbauer spectrometry. The instrumental facilities of the IMMM combining temperature, external magnetic field, *in situ* measurements developed during the last fifty years (arrival of Mössbauer spectrometry in Le Mans in 1974) and the expertise in modeling the Mössbauer spectra, have allowed the acquisition of many original results, the development of numerous scientific collaborations and the contribution of regional, national and international financial support ensuring the maintenance and the use of the instrumental facilities. A second complementary approach of the group is based on computer modeling with the implementation of clusters equipped with optimal numerical architectures (GPU, multi-core, multi-thread) having evolved over the last 20 years and the adaptation of codes (DFT, Monte Carlo, molecular dynamics) for the description of experimental results and thus to understand physical phenomena (e.g. structure and surface magnetism, chemical nature of grafting of molecules on nanoparticles, etc.).

« Conventional » Mössbauer spectrometry has become a routine technique over the last thirty years, but it remains necessary to have a solid knowledge of its fundamental features in order to extract relevant and physical information from the hyperfine structures of the spectra obtained under different stimuli (temperature, magnetic field, atmosphere, pressure, etc.). In addition, it now requires a new approach with the use of synchrotron sources allowing a time scale study thanks to « large » instrumental facilities such as ESRF, DESY, SPRING8 or BROOKHAVEN, as well as the versatility of the modes of application. In addition, circular dichroism (XMCD) would allow expanding the spectrum of information of the work developed by the members of the research group.

In this context, IMMM wishes to position the research project supported by the long (5 years) post-doc, the objective of which is to maintain the current activities centred on "conventional" Mössbauer spectrometry in the frame of national and international

collaborative projects, and to use large instruments (synchrotron facilities). These approaches based on these different complementary techniques would also support physicists of IMMM, working on the study of physical phenomena using ultrafast light sources and/or optical and ultrafast spectroscopy techniques in the linear and non-linear regime, in order to better understand physical phenomena at ultra-short time scales (among others magnetism, plasmonics, etc.) and moreover with traditional but crucial characterizations at the meso- and nanometric scales of functional materials developed by other IMMM actors. For example, chemists are interested in ^{57}Fe Mössbauer spectrometry studies, which provide useful information to characterize their crystalline nano- and micro-structured materials (oxidation states and local environments of iron) in order to better understand the structure-properties relationships.