Proposition of a Post-doc position in the framework of the CIRCOREX project (Carnot ESP)

Research topic : Self-oriented hexaferrites for self-biased circulators and isolators

Research laboratory : Groupe de Physique des Matériaux (GPM), Université de Rouen Normandie, France, ERMMA group (Magnetic Materials for Applications)

Dates : January 2022 for a period of 12 months

Requirements : Successful candidate will have a Ph. D in Materials Science, Chemistry, Physics, Chemical Engineering or a closely allied field and have a strong background in materials characterization

Details :

Hexagonal ferrites are a class of magnetic materials that potentially can play an important role in the propagation of electromagnetic waves in microwave and millimeter waves devices. These components are an important part of diverse range of commercial and military applications, including radar, wireless and satellite communications. In particular, a key component of radar electronics is the circulator. Ferrite circulators are passive components used to distribute signals in a three-port radar or wireless communication system. By proper design, it can be made that one port becomes “invisible”, or in a microwave engineer’s word, isolated, from another port. However reversely the port can see a through path to that port without problem. This is the non-reciprocal property of the circulator. A long-standing problem with conventional ferrite circulators is the permanent magnets placed above and/or below ferrite pellets to provide the necessary biasing magnetic field for operation. Rare Earth Elements are used in the production of magnets, which exposes manufacturers and systems integrators to supply chain risks. Due to their relatively large weight, permanent magnets tend to detach in high shock or vibration environments causing system failures. This issue is particularly acute in radar systems that require thousands, or even tens thousands, of circulators. The elimination of these magnets has long been the goal of device manufacturers.

Recently, a new substrate has been developed that do not require permanent magnets [1]. In such self-biased circulators, the pellet is created by aligning the magnetic grains of hard hexaferrite by applying a magnetic field and then processing the material at high temperature to create a dense compact which act as a magnet itself.

The aim of this project, funded by the Institut Carnot ESP (Energie et Systèmes de Propulsion), is to prepare and characterize disks made of polycrystalline hexaferrite with platelet shape obtained by hydrothermal synthesis [2]. The advantage of this type of powder is that, due to their shape, the alignment of the grains is obtained by pressing only and the application of a magnetic field during the creation of the pellet is not necessary [3]. This would simplify the manufacture of such pellets.

The candidate will perform the syntheses of the powders and the pellets, and he/she will be in charge of characterization by X-Ray diffraction, Scanning Electron Microscopy, ^{57}Fe Mossbauer

Spectroscopy and Squid Magnetometry. Knowledge in microwave measurements would be appreciated.
This study will be performed in collaboration with IRSEEM (Research Institute for Embedded Electronic Systems).

Interested and qualified persons should submit a letter describing their background and specific experience and capabilities, full curriculum vitae, copies of recent publications, and the name, e-mail address of at least one reference.

[1] https://www.mtmgx.com/
[2] M. Jean et al., J. Alloys Compd, 496 (2010) 306-312
[3] M. Saura-Muzquiz et al., ACS Appl. Nano Mater., 1 (2018) 6938-6949

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Closing date for application : 15/12/2021