FERFIT: Ferrite Thick Films for Integrated Circuits

PROJECT DESCRIPTION

The main driving force for the FERFIT project represents a new generation of self-biased mm-wave circulators based on barium ferrite for integrated circuits.

THE TELECOMMUNICATIONS MARKET needs for mm-wave magnetic devices will start to increase rapidly. One of the major stakes is the development of new technological processes suitable for innovative communication systems. The challenge is to manufacture, with lower costs, microwave Transmit/Receive (T/R) modules that not only exhibit high efficiency in terms of electrical characteristics (noise, linearity, consumption) at increasingly high frequencies, largely exceeding those of the centimeter-wave range, but also present new functionalities (self-biasing, tunability, multichannel operation) as well as a greater compactness and integration.

The only suitable materials for a circulator operating at such high frequencies are hexaferrites based on barium ferrite with the chemical formula $BaFe_{12}O_{19}$ because this is the least complex hexaferrite and posses all the required properties for mm-wave applications: high magneto crystalline anisotropy and a high saturation magnetization. Furthermore, the self-biased character of hexaferrite materials is an advantage for the miniaturization of circulators (no permanent magnet is needed).

Several techniques have been reported as being suitable for the preparation of thick ferrite films: sputtering, liquid-phase epitaxy, plasma spraying, slurry coating and screen-printing (SP). However, so far, the successful preparation of fully oriented hexaferrite films was reported only for screen-printing, when the low-temperature annealing was performed under an applied magnetic field. It is also known that tape casting (TC) induces the partial orientation of anisotropic grains. Recently, electrophoretic deposition (EPD) was successfully applied for the preparation of partly oriented films of YBCO, Al_2O_3 and TiO_2 in combination with an external magnetic field.
The basis for the successful preparation of thick films with all the selected methods is stable suspensions. The reduced stability of the suspensions can be theoretically overcome by a suitable functionalisation of the particles' surfaces.

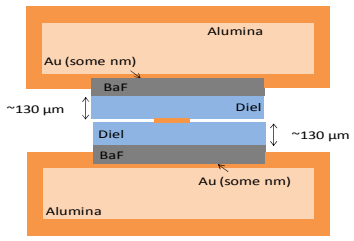
The overall objectives of the proposed project are:

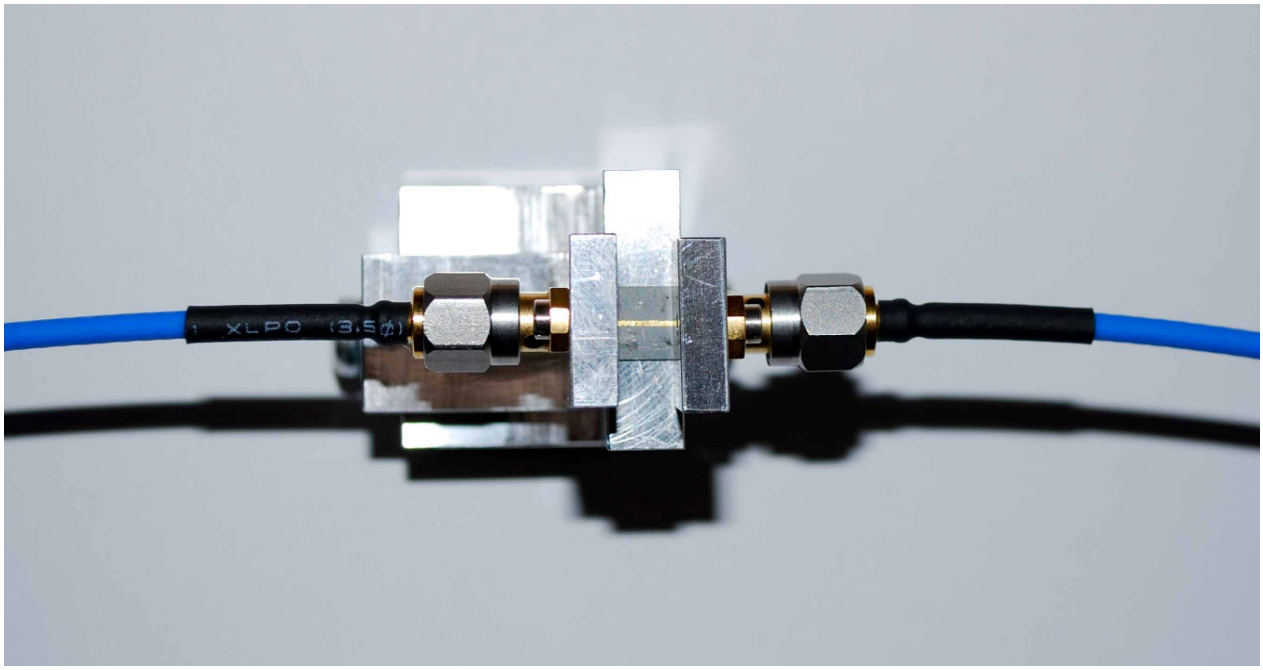
-to obtain knowledge for the preparation of magnetically oriented barium ferrite thick films,
-to develop the materials and technology for the production of mm-wave circulators,
-to develop the theoretical tools for the design of self-biased mm-wave circulators,
-to provide new knowledge on magnetic materials and mm-wave devices interesting for EU's telecommunications, automobile and magnetic-material producers.

The expected results are as follows:

-a synthesis method for barium ferrite nanoparticles with a homogeneous particle size,
-functionalized barium ferrite particles suitable for their dispersion in liquid media,
-the mechanism and conditions for the electrophoretic deposition of barium ferrite particles in combination with an external magnetic field,
-magnetically oriented thick films from barium ferrite,
-new equipment for thick-film technology under an applied magnetic field,

-electromagnetic measuring systems for mm-waves,
-a new circulator design approach,
-a new mm-wave circulator feasibility study

		
Microstrip 1.	*Stripline*	*Microstrip 2.*



PARTNERS

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PROJECT DURATION AND TOTAL PROJECT COST:

Duration: 10/01/2010-12/12/2012
Cost: 785.865 €

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