2019 MMM Conference

View Abstract

CONTROL ID: 3254989

PRESENTATION TYPE: Oral

CURRENT CATEGORY: X. Sensors, High Frequency Devices and Power Devices

CURRENT SUB-CATEGORY: b. High-Frequency, Microwave, and Millimeter Wave Devices

TITLE: Strong Coupling of Magnons to Microwave Photons in Three-Dimensional Printed Resonators

AUTHORS (FIRST NAME, LAST NAME): Jeremy Bourhill[1, 2], Sami Ben Ammar[1], Gwendal Cochet[3], Alexandre Manchec[3], Vincent M. Castel[1, 2]

INSTITUTIONS (ALL): 1. IMT Atlantique, Technopole Brest-Iroise, CS 83818, Brest, France.
2. Lab-STICC (UMR 6285), CNRS, Technopole Brest-Iroise, CS 83818, Brest, France.
3. Elliptika (GTID), Brest, France.

ABSTRACT BODY:
Abstract Body: In recent years, a new light–matter interaction platform has been developed [1-2] by combining microwave (MW) photons residing in a resonant cavity with magnons in magnetic materials with a high spin density, such as yttrium iron garnet (YIG) [3]. The use of a standard three-dimensional (3-D) cavity for MW applications seems difficult to combine with concepts of integration, compactness, cost, and miniaturization. Here, we propose to take advantage of the geometric configuration of a re-entrant MW cavity to counterbalance this problem, which is becoming more and more critical by reducing the working frequency. MW re-entrant cavities offer many advantages in terms of frequency tunability, volume reduction, and control of the MW magnetic field distribution while keeping a high Q factor. Such cavities have been used for decades for a variety of applications, such as high Q resonator or sensors, and in different research area from the observation of spin wave propagation [3] to studies of cavity magnon–polaritons [4]. A range of experimental and simulations results are presented for two YIG/cavity systems, demonstrating the strong coupling signature (see Fig.1) between a YIG thin film resonator and photons generated by a 3-D re-entrant cavity elaborated by additive manufacturing (see Fig.2). A frequency dependence of the coupling strength was observed for both cavities, which differ only with the inner post height. Additive manufacturing opens an innovative path for the development of a new class of 3-D tunable filters based on re-entrant cavities, adjustable inner posts (including exotic shape), iris aperture, and magnon-photon coupling control. Such elaboration procedure combined to re-entrant cavities features improve the integration of YIG/Pt systems without increasing the intrinsic loss rate of the cavity, adding another degree of freedom in terms of tunability [5].

References: [1] Y. Tabuchi, S. Ishino, Y. Nakamura, Phys. Rev. Lett., Vol. 113, p.083603 (2014)
[2] L. Bai, M. Harder, Y.P. Chen, X. Fan X, J.Q. Xiao, C-M. Hu, Phys. Rev. Lett., Vol. 114, p.227201 (2015)
[3] J.R. Eshbach, Phys. Rev. Lett., Vol. 8, p.357 (1962)
[4] M. Goryachev, J. Bourhill, M. Kostylev, M.E. Tobar, *Phys. Rev. B*, Vol. 97, p.155129 (2018)
[5] V. Castel, A. Manchec, G.E.W. Bauer, Phys. Rev. B, Vol. 96, p.064407 (2017)

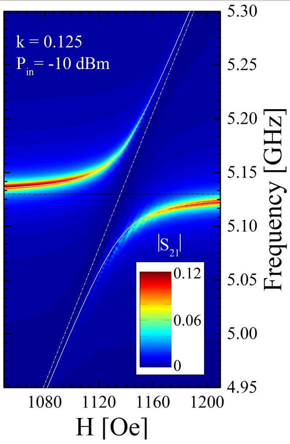

Fig.1 Experimental observation of the anticrossing region at room temperature with the dark mode. Measurement of the transmission amplitude |S21| of the resonator system as function of the frequency and the applied static magnetic field.

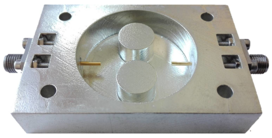

Fig.2 Photograph of the 3-D printed cavity (without lid).

CONTACT (NAME ONLY): Vincent Castel

CONTACT (EMAIL ONLY): vincent.castel@imt-atlantique.fr

Manuscript?: Undecided

Previous Presentation: Intermag 2018

Attendance at Conference: I acknowledge that I have read the above statement regarding the requirement that an author of this presentation must attend the conference to present the paper.