

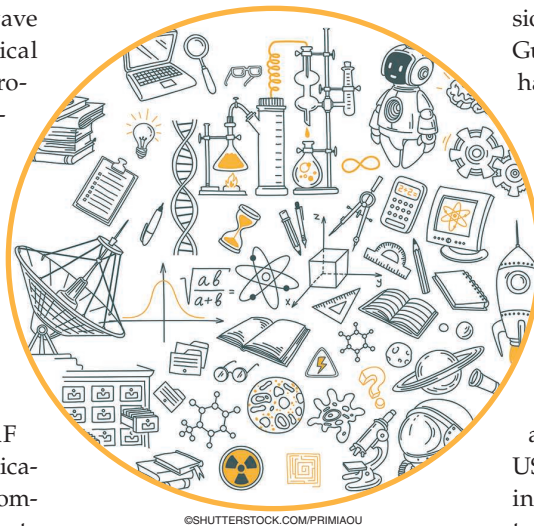


MTT-S Society News

Technical Committee 13 Report 2020–2022

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The mission of the Microwave Control Techniques Technical Committee (TC-13) is to promote research in functional materials alongside their application in RF components, such as circulators, phase shifters, limiters, and RF filters. A wide range of materials, such as piezoelectric, ferroelectric, ferromagnetic, and phase-change (e.g., metal-insulator transition switches) materials, is within the scope of TC-13's research, targeting emerging RF applications, such as 6G communications, radar sensing, and military communications. The committee's interests



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sionals (YPs) were added in 2022, and Guoan Wang and Dimitra Psychogiou have been co-chairing TC-13 since January 2021. Our members come from academia, industry, and government and have been actively contributing as lead researchers in the TC-13 areas of interest by publishing in high-impact IEEE conferences and journals. Example technical contributions from our members are summarized as follows. Chris Nordquist's group at Sandia National Laboratories, USA, demonstrated in [1] a method to increase the quality factor (Q) of contour mode AlN-based resonators by incorporating curved electrodes that consecrate the energy toward the resonator center, increasing the Q to 1,520 and leading to a higher figure of merit than state-of-the-art AlN resonators. Mortazawi's group at the University of Michigan, MI, USA, investigated the potential of intrinsically switchable BST-based thin-film bulk acoustic resonators (FBARs) for the realization of intrinsically switchable quad-channel filter banks that facilitate discrete tuning of a passband filtering response between 1.7 and 2 GHz, as shown in Figure 1 [2]. A new class of acoustic wave resonator-based RF filters with

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span across modeling, design, fabrication, and characterization of these materials and their corresponding RF components. Controllability of the material properties under external stimuli is also an important area of research to enable tunability and miniaturization of key antenna and RF front-end components.

Technical Highlights

Chaired by Dimitra Psychogiou and Chris Nordquist in 2020–2021, TC-13 had 20 regular members. Three new affiliate members (AMs)/Young Profes-

multiconfigurable transfer function capabilities was demonstrated by Dimitra Psychogiou's group at Tyndall National Institute and University College Cork, Cork, Ireland in [3]. It was shown that, by combining acoustic wave and electromagnetic wave resonators alongside RF switches, highly selective transfer functions with multiple levels of RF tuning, including an all-stop, a single-band, a dual-band, and a triple-band response, can be realized. Our TC members A. Geiler, M. Geiler, and P. Kulik (new AMs and YPs) published an article [4] on microwave magnetic materials and their applications in frequency-selective limiters. The article covered fundamental design methodologies and investigated their effectiveness in suppressing interference within an RF canceller. In [5], A. Shamim's group at King Abdullah University of Science and Technology, Saudi Arabia, demonstrated the potential to realize low-cost and flexible tunable RF filters by incorporating inkjet-printed vanadium dioxide (VO₂)-based switches. Singh (a new AM and YP) and Mansour demonstrated the potential of using germanium telluride (GeTe) for the realization of low-loss and high-frequency RF switch networks in [6]. Specifically, 2 × 2 and 4 × 4 switch matrices (see Figure 2) with low loss (<1.35 dB in a 2 × 2 switch matrix) and high isolation (>24 dB) were shown for frequencies as high as 40 GHz.

Further contributions of TC-13 in the area of magnetic materials and nonreciprocal RF devices were presented in the November 2022 special issue of *IEEE Microwave Magazine* on microwave magnetics [7], [8]. The special issue was led by Chris Nordquist as guest editor. It comprised three articles [9], [10], [11] and summarized recent progress in nonreciprocal and tunable circuits using new types of magnetic materials. The articles covered multidisciplinary areas of micromagnetics from fundamental physics, to modeling, and circuit design and characterization. In [9], Gao et al. introduced circuit

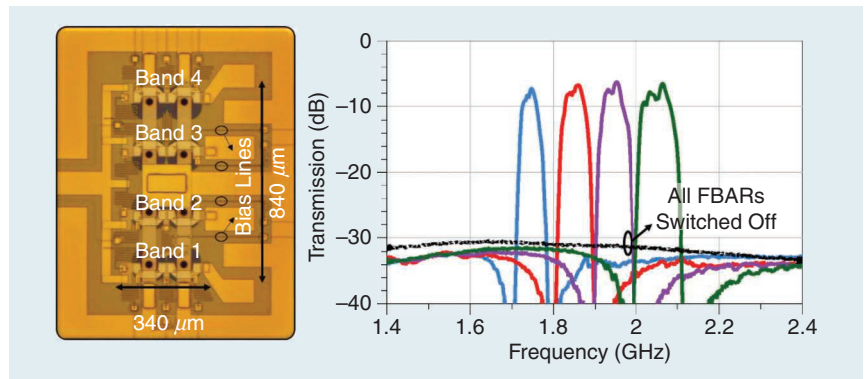


Figure 1. BST FBAR quad-channel filter bank using four 2.5 stage intrinsically switchable 2.5 stage bandpass filters. (Source: [2].)

equivalent models for the modeling of linear and nonlinear spin precessions and spin-wave propagation in RF magnetic materials using circuit design tools facilitating the design of magnetic devices using conventional circuit simulators. Ge et al. in [10] provided a comprehensive overview of the applications of ferromagnetic thin-film materials for the design of tunable passive components and flexible reconfigurable components and demonstrated their potential for miniaturization, performance enhancement, and tunability. In [11], Ueda presented the potential of nonreciprocal magnetic materials for the realization of leaky-wave antennas with improved squint and dispersion.

Public Engagement and Service

Within the course of the past two years, TC-13 sponsored three workshops at the IEEE International Microwave Symposium (IMS). Specifically, our TC members Chris Nordquist and Dimitra Psychogiou organized the Microwave Magnetic Materials and Devices for Novel Microwave Functionality workshop at IMS 2021, and A. Shamim, G. Hummel (new AMs and YPs), and Tejinder Singh (new AM and YP) organized the Emerging MIT/PCM-Based Reconfigurable Microwave Devices workshop at IMS 2022. Dimitra Psychogiou also organized a workshop at IMS 2022, called Advanced Manufacturing and Design Techniques for Emerging 3D Microwave and mm-Wave RF Filters, cosponsored with the Fil-

ters Committee (TC-5). All of these workshops were well attended and facilitated interactions among our TC members and other researchers/engineers from industry and academia. As direct outcomes of these engagements, a special issue on microwave magnetics was published in *IEEE Microwave Magazine* in November 2022 [7], [8]. Furthermore, many of our TC-13 members have been contributing to IEEE service. Specifically, many of our members are serving on the technical program committees/technical program reviewers committees of IEEE and European

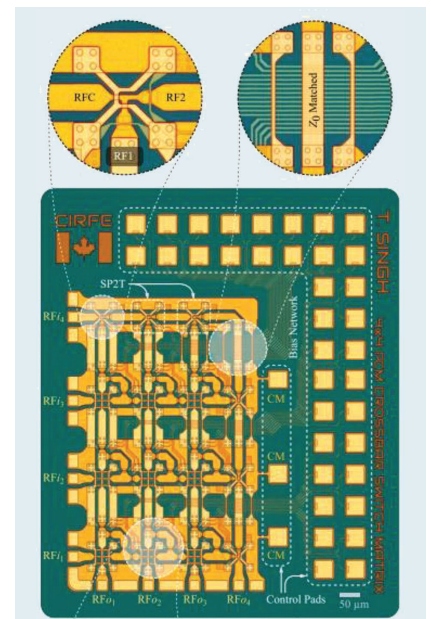


Figure 2. A 4 × 4 PCM GeTe-based switch matrix for dc-40-GHz multiport RF switching. PCM: pulse-code modulation. (Source: [6].)

Microwave Association (EuMA) conferences (e.g., at the IMS, IEEE MTT-S International Wireless Symposium, and European Microwave Conference). Dimitra Psychogiou is serving as associate editor (AE) of *IEEE Microwave Wireless and Components Letters* and *EuMA International Journal of Microwave and Wireless Technologies*. Chris Nordquist is the topic editor of *IEEE Journal of Microwaves*, and A. Shamim has been serving as an AE of *IEEE Journal of Electromagnetics, RF and Microwaves in Medicine and Biology*. Tejinder Singh is editor-in-chief of *IEEE MTT-S Student Newsletters* and managing editor of *MTT-S e-Newsletter*. T. Ueda, Z. Yao, and Guoan Wang serve as speakers of the IEEE Microwave Theory and Technology Society (MTT-S) Speakers Bureau.

Awards

In 2021, Dimitra Psychogiou received the Roberto Sorrentino Prize from the EuMA, RF Microtech, and SIEM. This prize recognizes an outstanding YP who has distinguished technical achievements within the microwave field.

Future Activities

TC-13 will continue to support the MTT-S with technical contributions

in the aforementioned areas and will engage with the public and YPs through workshops, the organization of special sessions, and student design competitions. Specifically, for 2023, TC-13 has already planned a workshop for IMS 2023, which will take place in San Diego on 11–16 June 2023. The workshop will be titled RF Devices Exploiting Intimately Coupled Multiphysics, and it will be organized by Chris Nordquist and Troy Olsson.

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Report on the IIT (BHU) Varanasi Student Branch Chapter Activities for 2022

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The IEEE Microwave Theory and Technology Society (MTT-S) Student Branch Chapter at the

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Indian Institute of Technology (IIT) Banaras Hindu University (BHU) Varanasi (SBC-M) has been continuing to organize technical talks after being selected for the Outstanding Chapter Award in 2022. Four distinct seminars were arranged during the period from May to December 2022, apart from a Young Professional's talk by Dr. Tushar Sharma [1]. The first seminar, "Devel-

opment of Photonic ASICs for Optical Remote Sensing missions of ISRO," was organized by the Chapter in conjunction with the IEEE Photonics SBC IIT BHU Varanasi (SBC-P) on 31 May 2022 (flyer shown in Figure 1). The event took place in IIT BHU's ABLT-1 Hall. More than 50 people from various departments at IIT BHU attended the lecture by Arup