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Compact and High Performance Microwave Superconducting Bandpass Filters Using Microstrip Multimode Resonators

*Haiwen Liu[1]

School of Electronics and Information Engineering, Xi'an Jiaotong University, Xi'an, 710049, China[1]

As the key passive component in the radio-frequency (RF) front-end, bandpass filter (BPF) with compact size and high performance are in great demand for enhancing system functionality. Meanwhile, high-temperature superconducting (HTS) materials are becoming more and more attractive in the context of designing microwave filters because of their lower losses and excellent performance.
In past few years, several types of high performance HTS BPFs have been designed for demonstration. For circuit size miniaturization, various microstrip multimode resonators have been proposed, such as the multi-stub-loaded resonators and square ring loaded resonator. At first, a series of the second-order multiband HTS filters have been presented based on the multi-stub-loaded resonators [1], [2]. The measured insertion losses are all extremely small, but the selectivity and stopband performance need to be improved because of the low-order design. Therefore, a newly dual-mode hairpin ring resonator is proposed and applied to constitute an eighth-order dual-band HTS BPF [3]. The configuration of the designed filter and the obtained frequency responses are respective shown in Fig. (a) and (b). As predicted, the band edge selectivity and the attenuation in stopband are highly enhanced.
In addition, the differential circuits have been received much attention recently due to their ability of lower electromagnetic noise and crosstalk. So, based on the HTS technology, a fourth-order differential dual-band HTS BPF has been designed using the proposed square ring loaded resonator [4]. The layout of the differential filter is depicted in Fig. (c) and the simulated results as well as the measured results are shown in Fig. (d). It is seen from Fig. (d) that a favorable common-mode (interference signal) suppression over a wide frequency range is obtained.
With the advantages of ultra-low in-band insertion losses and high selectivity, these proposed filters are attractive for potential applications in multiband communication systems requiring high-sensitivity and high anti-interference properties.

[1] H. W. Liu, J. H. Lei, X. H. Guan, L. Sun, and Y. S. He, “Compact triple-band high-temperature superconducting filter using multimode stub-loaded resonator for ISM, WiMAX, and WLAN Applications,” IEEE Transactions on Applied Superconductivity, vol. 23, no. 6, Art. ID. 1502406, Dec. 2013.
[2] H. W. Liu, P. Wen, Y. L. Zhao, B. P. Ren, X. M. Wang, and X. H. Guan, “Dual-band superconducting bandpass filter using quadruple-mode resonator,” IEEE Transactions on Applied Superconductivity, vol. 24, no. 2, pp. 130-133, Apr. 2014.
[3] H. W. Liu, B. P. Ren, S. X. Hu, X. H. Guan, P. Wen, and J. M. Tang, “High-order dual-band superconducting bandpass filter with controllable bandwidths and multitransmission zeros,” IEEE Trans. Microw. Theory Tech., vol. 65, no. 10, pp.3813-3823, Nov. 2017.
[4] B. P. Ren, Z. W. Ma, H. W. Liu, X. H. Guan, X. L. Wang, P. Wen, and M. Ohira, “Differential Dual-Band Superconducting Bandpass Filter Using Multi-Mode Square Ring Loaded Resonators With Controllable Bandwidths,” IEEE Transactions on Microwave Theory and Techniques, vol. 67, no. 2, pp. 726-737, Feb. 2019.