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Single Magnetic Bias Magnetostatic Wave Ladder Filter

A compact, wafer-scale magnetostatic filter platform offers wide tunability and low loss for high-frequency 5G and 6G communication systems.

Researchers at Purdue University have developed a single magnetic bias magnetostatic wave (MSW) ladder filter to address the high-frequency, wide-bandwidth needs of next-generation 5G and 6G communication systems. Traditional electromagnetic and acoustic filters face limitations in size, tunability, and scalability at higher frequencies. This innovation introduces a magnetostatic ladder filter fabricated using a novel "Hairclip" process on YIG-on-GGG substrates. By precisely shaping YIG resonators through lithographic ion milling, the design achieves wide bandwidth filtering using a single magnetic bias fieldâ€”eliminating the need for complex multi-bias configurations. The result is a compact, tunable, and scalable filter platform with demonstrated high Q and coupling, enabling performance previously unattainable in thin-film YIG devices. Moreover, the wafer-scale manufacturable device supports operation from 7 GHz to 20 GHz with low insertion loss, enabling efficient, portable, and scalable solutions for advanced mobile communication technologies.

Technology Validation:

Prototype YIG-on-GGG magnetostatic wave ladder filters achieved a 15.2 GHz center frequency, 8.4% coupling, and Q_p of 687 (FOM = 57.6). Single magnetic bias enabled tunability from 7â€“20 GHz with low insertion loss and strong out-of-band rejection. Results confirm improved coupling and bandwidth over conventional MSW filters, with optimization potential for scalable high-frequency communications.

Publication:

https://www.nature.com/articles/s41928-025-01345-x

Advantages:

-High-frequency operation (7â€“20 GHz)

Technology ID

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Category

Semiconductors/Devices & Components
Materials Science & Nanotechnology/Advanced Functional Materials

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-Wide tunability with single magnetic bias

-Low insertion loss

-Strong out-of-band rejection

-Compact, wafer-scale manufacturable design

-Improved bandwidth and coupling over conventional MSW filters

Applications:

-5G and 6G communication systems

-Portable and mobile devices

-Satellite communications

-High-frequency radar systems

-Wireless infrastructure equipment

TRL: 3

Intellectual Property:

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Keywords: magnetostatic wave ladder filter, MSW filter, YIG-on-GGG, 5G communication systems, 6G communication systems, high-frequency filter, wide-bandwidth filter, single magnetic bias, wafer-scale manufacturable, YIG resonators, wireless infrastructure, mobile communication technology, 5G/6G communications, Electrical Engineering, high-frequency filters, lithographic ion milling, low insertion loss, magnetostatic wave (MSW), Materials and Manufacturing, RF components, single magnetic bias, tunable bandpass filter, wafer-scale fabrication, wide bandwidth, YIG-on-GGG platform