COST-EFFECTIVE BROADBAND METASURFACE FILTER

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This article introduces a new cost-effective frequency-selective surface (FSS) bandpass filter. Traditional wideband polarization-independent FSS bandpass filters often involve multiple microwave dielectric substrates or non-commercial composite materials, leading to high manufacturing costs. In contrast, the proposed FSS filter avoids using microwave substrates and active devices [1]. Its symmetrical configuration enables a broad, controllable operational frequency band that supports all polarizations. The filter comprises three thin metal sheets, incorporating a metallic substrate and dipole resonators. The metallic substrate ensures mechanical integrity with no additional RF restrictions across the operating frequency band. Integrating the substrate and dipoles enables a fully controllable wideband response, validated through circuital and modal analyses. The predicted and measured results demonstrate a substantial bandwidth above 30%, with sharp roll-offs for the normal incidence. Results indicate a low sensitivity of the FSS filter response to oblique angles of incidence.

The proposed spatial filter has two fully adjustable resonances, facilitating the passband's fine-tuning. The metallic segments exclusively influence one resonance, while metallic and air-gap segments control the other. To explain the tunability of the filter, two LC models are extracted for the case of loose and tight couplings based on even-odd mode analysis. Fig. 1 shows the metasurface schematic and its passband tunability. Fig. 2 depicts one of the LC models (loose coupling) and the final metasurface response.

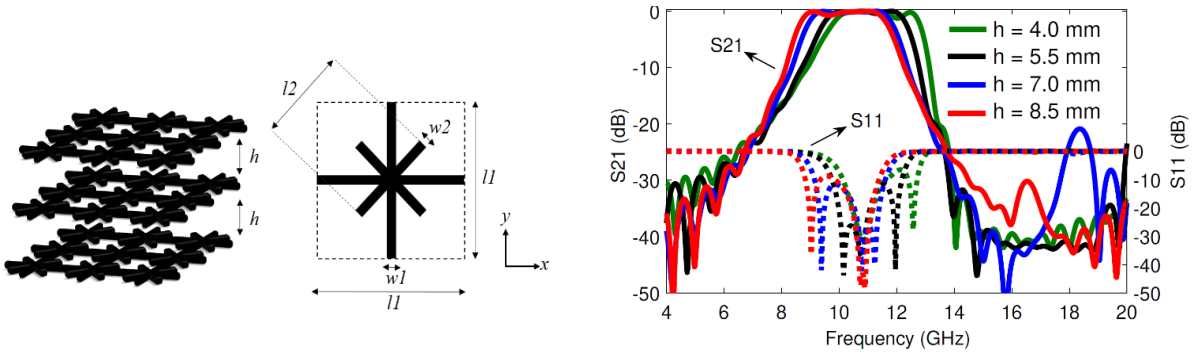

Fig. 1 (left): the configuration of the metasurface filter, (right): passband adjustability.

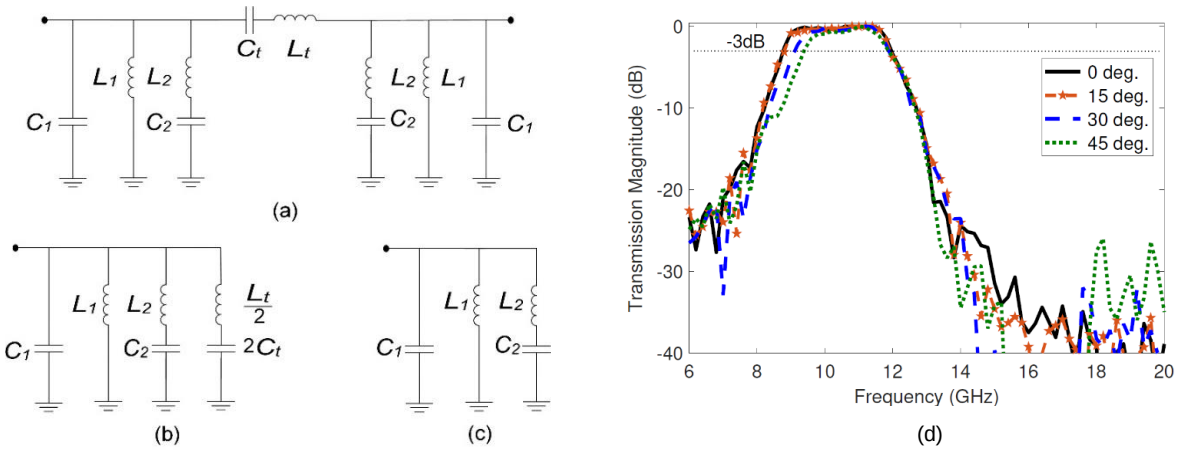

Fig. 2: (a) LC model for loose coupling, (b) odd mode, (c) even mode, (d) filter measured response of the filter for oblique incidence.

[1] S. M. A. M. H. Abadi, M. Li, and N. Behdad, "Harmonic-suppressed miniaturized-element frequency selective surfaces with higher-order bandpass responses," IEEE Transactions on Antennas and Propagation,vol. 62, no. 5, pp. 2562–2571, 2014.