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Innovative MIM diplexer with neural network enhanced refractive index detection for advanced photonic applications

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Erratum in

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Abstract

This study introduces a high-performance 4-channel Metal-Insulator-Metal (MIM) diplexer, employing silver and Teflon, optimized for advanced photonic applications. The proposed diplexer, configured with two novel band-pass filters (BPFs), operates across four distinct wavelength bands (843 nm, 1090 nm, 1452 nm, 1675 nm) by precisely manipulating the passband dimensions. Utilizing Finite-Difference Time-Domain (FDTD) simulations, the designed diplexer achieves exceptional sensitivity values of 3500 nm/RIU, 4250 nm/RIU, 3375 nm/RIU, and 4003 nm/RIU, along with high figures of merit (FOM) ranging from 113.4 to 124.7 1/RIU. Also, the compact design (400 nm × 830 nm) underscores its suitability for integrated photonic circuits and advanced sensing applications. Furthermore, to further enhance accuracy in detecting refractive index (RI) changes, a multilayer perceptron (MLP) neural network was employed, ensuring the highest sensor accuracy. The accuracy of the MIM diplexer's RI measurements was statistically validated through a one-sample t-test, confirming the sensor's reliability. Comparative analysis with existing sensors highlights the diplexer's superior sensitivity and efficiency, setting a new benchmark in optical communication and photonic sensing technologies. This work paves the way for future advancements in miniaturized, high-sensitivity optical devices, offering robust solutions for next-generation communication and sensing systems.

Keywords: High sensitivity; MIM diplexer; MLP neural network; Photonic sensors; Refractive index detection.

Figures

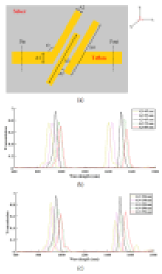

Fig. 1 (**a**) The layout...

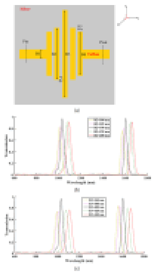

Fig. 2 (**a**) The layout...

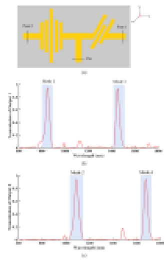

Fig. 3 (**a**) The structure,...

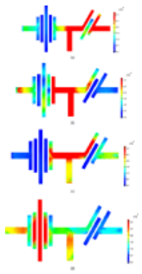

Fig. 4 The field profile of the...

Fig. 5 Flowchart of the RI sensing...

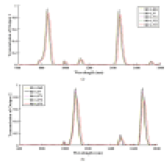

Fig. 6 Simulation results of transmission rate...

All figures (9)

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