

[EN-A-082] Wireless-optical signal converter utilizing stacked-patch antennas and electro-optic substrates

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Abstract: We have proposed a new wireless electro-optic (EO) modulator using multi-layered stacked patch-antennas with a narrow gap for radio-over-fiber applications. This device uses a structure of vertically stacked patch antennas like the Yagi-Uda antenna, with an EO crystal and low-dielectric-constant material hybrid substrate. The electric field for optical modulation and the patch length are increased by using the multi-layered antenna stacked structure, and the conversion efficiency from wireless to optical signals can be improved.

The basic structure of the proposed EO modulator using stacked patch-antennas is shown in Fig. 1, where the two square patch-antennas and multiple substrates of a z-cut LiNbO₃ film (50 μm thick) and a SiO₂ plate (250 μm thick) are stacked vertically to increase antenna gain. In the lower level patch antenna, a narrow (~5 μm) gap is introduced at the center of the patch metal, and a single-mode straight optical waveguide is set along the gap in the LiNbO₃ crystal. This gap is used as an electrode for optical modulation by use of a displacement current.

In the analysis by use of HFSS, the operational frequency was shifted to the higher by 7GHz in the 60 GHz band, and the modulation index improved by 3.2 dB using a double stacked structure. Fig. 2 shows the measured frequency responses of the fabricated EO modulators, where the improvement of the modulation index by 3 dB (the improvement of the carrier/sideband ratio by 6 dB) was verified. These frequency responses were in good agreement with the calculated results. The conversion of wireless 60 GHz band signals with QPSK modulation and its transfer over 1 km long fiber were also demonstrated. Details will be presented in the conference.

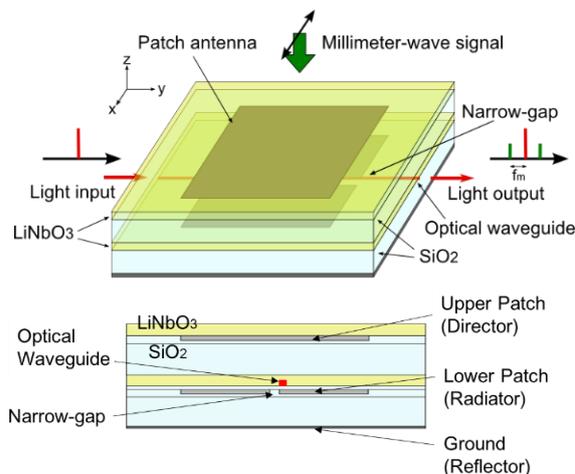


Figure 1. Structure of the EO modulator using stacked patch-antennas.

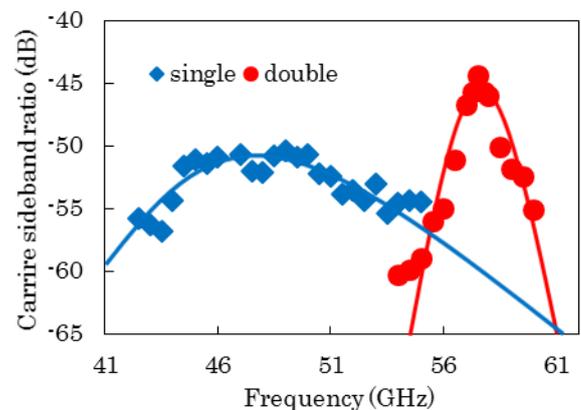


Figure 2. Measured frequency response.

Keywords: Planar antenna; Electro-optic effect; Yagi-Uda antenna; Radio over fiber; Optical modulator