Microwave-Light-Microwave Transformation in Optical Line Based on Magnetooptical Modulator

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Microwave-optical transmission lines are of great interest now for their application in high-speed communication systems as well as in different microwave systems. Recently, at the previous SSDM Conference [1], we described some planar microwave magnetooptical modulators, based on waveguide-light (WL) interaction with magnetostatic waves (MSW) in ferrite films. which may be used in such transmission lines.

Herein we report on the realization of complete microwave-light-microwave transformation in optical line consisting of a semiconductor laser, a planar magnetooptical modulator and a semiconductor pin-diode. The modulator using collinear WL-MSW interaction was made on 8.7 μm thickness yttrium-iron-garnet (YIG) epitaxial film. The solid-state GaAs-laser of 2 mW output power and 1.3μm wavelength served as a light source. Surface MSW were excited by a 100 mW power microwave signal in the f=3-5 GHz frequency range. A specially selected high-speed pin-diode, those frequency response is shown in Fig.1, was used for optical signal demodulation.

The input light beam coupled into the ferrite film was split to three optical modes: incident TM-mode, TE-mode caused by a statical Faraday effect without any frequency shift and TE-mode created by a dynamic Faraday effect. The third one had a frequency modulation equal to the MSW frequency. Statically and dynamically transformed modes were collinear and quite similar as the modes of one TE-type. Two these modes were combined and intefered on the pin-diode window thus providing the conversion of frequency modulation to amplitude light modulation. As a result of a heterodyne effect a microwave signal appeared at the diod output.

Fig.2 shows the dependence of the diode output signal on microwave frequency f when Bragg conditions for WL-MSW interaction are satisfied (curve 2) and in the absence of microwaves (curve 1). The transmission bandwidth obtained was equal to 20 MHz and signal to noise ratio was approximately 5 dB. Both these values may be improved sufficiently by using Bi-doped YIG film in modulator or by including of light amplifier in the transmission line. The operating interval of this line may practically reach 3-10 GHz.

**Fig. 1** Frequency response of pin-diod.

**Fig. 2.** Frequency response of transmission line.