Residual amplitude modulation and birefringence effects in EOM and AOM-RN

V. Baryshev and E. Aleynikova

FGUP "VNIIFTRI", Mendeleevo, Moscow Region, Russian Federation

Email: baryshev@vniiftri.ru

It has been shown in [1] that AOM-RN, an acousto-optic modulator operating purely in the Raman-Nath diffraction regime, extended the tools employed in laser spectroscopy as optical phase modulators. To date, the electro-optic modulator is commonly employed as a phase modulator in FM spectroscopy (FMS). Since the acousto-optic and electro-optic interactions differ in their physical nature, it seems to be interesting to investigate the effects having the same origin in both of EOM and AOM-RN. These are RAM and birefringence effects deteriorating the noise performances of the signals obtained by FMS.

We will present the comparative analysis of the mentioned effects in particular case of commercial 20 MHz resonant EOM from Thorlabs and broadband AOM-RN from VNIIFTRI (Fig.1). The electro-optic interaction length or thickness of the MgO doped $LiNbO_3$ crystal is 40 mm and the thickness of AOM-RN TeO_2 crystal is 5 mm. Both the crystals are birefringent. An optical wave with polarization direction not coinciding with crystals any optical axis will experience polarization rotation. That leads to the additional amplitude modulation if any polarizing element is placed in the optical set-up behind the EOM or AOM-RN. Fig. 2 shows a fractional power of the output beam component produced by the birefringence effect in EOM and AOM-RN in dependence of the angle θ between crystals optical axis and vertical direction of the input laser beam.

We will show in comparison with EOM that all AOM-RN performances related to RAM and birefringence effects are favorably defined by the reduced dependence of diffraction intensity on acousto-optic interaction length L or due to the almost one order difference in the acousto-optic and electro-optic interaction lengths.

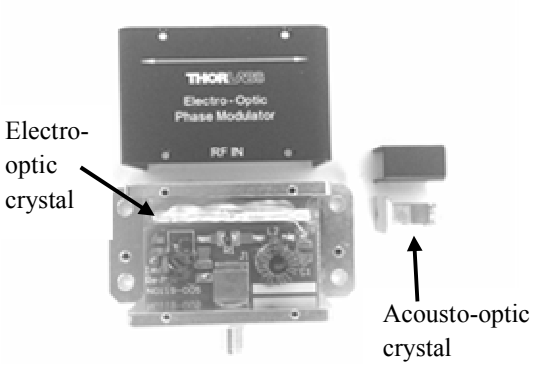

Fig. 1. Photographs of Thorlabs EO-PM-R-20-C1 EOM and VNIIFTRI AOM-RN.

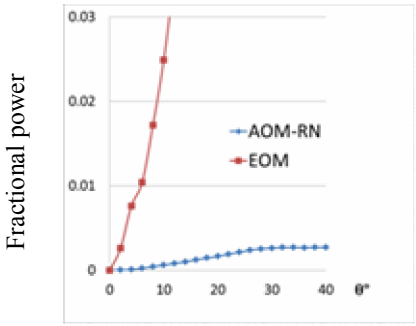

Fig. 2. Fractional power of the output beam component produced by the birefringence effect.

[1] V. N. Baryshev, "Laser frequency stabilization by the Pound-Drever-Hall method using an acousto-optic modulator operating in the pure Raman-Nath diffraction regime", vol. 42, No. 4, pp. 315-318, 2012.