Terahertz Generation in Free Space and in Waveguide Partially Loaded With Nonlinear Crystal

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To trigger the enormous application potential of the teraherz (THz) band an efficient powerful source of coherent THz radiation is an essential requirement. The efficiency of difference frequency generation (DFG), a widely used approach to generate broadband THz radiation, depends on the condition of wave synchronism. The use of waveguide was suggested in [1] to enhance the wave synchronism by increasing the phase velocity of terahertz radiation in waveguide. This helps to reduce the differences in refractive indices at THz and pump frequencies incurred by dispersion and to bring some of waveguide modes closer to synchronism. In this report we demonstrate this enhancement achieved at THz frequencies using a partially loaded by a nonlinear crystal terahertz waveguide. In this case the nonlinear crystal, $LiNbO_3$, works as a nonlinear frequency convertor in the combined structure "waveguide + crystal".

We present the experimental results on THz generation in a waveguide partially loaded with $LiNbO_3$ crystal using 50 fsec pulses Ti:sapphire laser. The outgoing radiation in the band 0.1-2.7 THz as the superposition of H_{mo} [1,2] modes was detected with a free space electro-optic setup. Following the experimental results we present a review on the theoretical calculations. The results have shown an order of magnitude enhancement of terahertz generation in the waveguide structures comparing with positioning samples in free space.

1. A.S.Nikoghosyan, Kvant.Electron. (Moscow) [Sov. J.Quantum Electron],15, 569, 1988
2. G.Galiot, S.P. Jamison, R.W. McGowan, D.Grischkowsky.J.Opt.Soc.Am.B.Vol17, p.851-863,2000