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Some properties of the mixed GaS0.4Se0.6 nonlinear crystal in comparison to GaSe

G. Marchev, A. Tyazhev, V. L. Panyutin, V. P. Petrov, F. Noack, K. Miyata, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany); M. Griepentrog, Bundesanstalt für Materialforschung und -prüfung (Germany)

Two essential advantages can be expected from adding S to the well known nonlinear crystal GaSe: increase of the band-gap value or the short wave cut-off limit and improved hardness. Recently, we confirmed that the non-centrosymmetric structure of GaSe is preserved up to a GaS content of 40 mol. % while the nonlinear coefficient d22 is reduced by only 24%. The increased band-gap results also in higher surface damage threshold. The first Sellmeier equations for GaS0.4Se0.6 were based on refractive index measurements. These equations were subsequently refined by fitting second-harmonic and difference-frequency generation phase-matching angle data in the mid-infrared as well as birefringence data in the visible and near-infrared obtained with thin phase retardation plates. The two-photon absorption effect was studied for GaS0.4Se0.6 and GaSe using amplified 1064 nm picosecond pulses at 10 Hz. The comparison indicated roughly an order of magnitude weaker two-photon absorption effect in GaS0.4Se0.6 in comparison to GaSe in the GW/cm2 intensity range. This means that GaS0.4Se0.6 could be safely used in Nd:YAG laser pumped nanosecond optical parametric oscillators or picosecond optical parametric amplifiers without nonlinear absorption. In the reported dynamic indentation measurements of GaS0.4Se0.6 and GaSe, the primary loading was controlled such that the strain rate was held constant at 0.05 s-1. The maximum indentation depth was 2 µm. Frequency and amplitude of the superimposed sinusoidal oscillation were 45 Hz and 2 nm, respectively. The Berkovich indenter used was a so-called AccuTipTM (Agilent), very sharp tips with a nominal tip radius of about 50 nm.