Yohei Sato et al., J Laser Opt Photonics 2017, 4:4 (Suppl)
DOI: 10.4172/2469-410X-C1-017

8th International Conference and Exhibition on

LASERS, OPTICS & PHOTONICS

November 15-17, 2017 | Las Vegas, USA

Liquid phase growth of GaSe crystal for highly efficient THz wave generation

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The applications of THz wave are expected in wide valiety of applications such as nondestructive inspection, medical science and ultra high density communication. In our laboratory, we research nondestructive inspection by using THz wave as follows: 1. Sensing of disconnection gaps covered with invisible insulator, 2. visualization of steel wire in the extradosed bridge cable and 3. qualitative and quantitative metal corrosion analysis etc. For these THz killer applications, non-linear optical gallium selenide (GaSe) is one of the most essential key materials for the highly efficient, widely frequency tunable and compact THz light source via difference frequency generation. The power of THz wave from commercially available Bridgman grown GaSe crystal is limited by the native point defects due to high temperature growth at melting point and the deviation from stoichiometric composition. In our laboratory, GaSe crystal is grown by TDM-CVP which enables extremely low growth temperature and application of Se vapor pressure for stoichiometry control. Conversion efficiency of THz wave generation at 9.41 THz using not-intentionally doped GaSe crystal grown by our TDM-CVP (1.2×10^{-6} J^{-1}) was 4 times higher than that from Bridgman-grown crystal (3.0×10^{-7} J^{-1}). In addition, we grew impurity doped GaSe crystal systematically for the first time. In low THz frequency range, transparency of GaSe crystals grown by TDM-CVP are improved by doping of amphoteric impurity (Ge) and transition metal (Ti). In the case of doping issoerectronic impurity (Te), It was confirmed to improve interlayer bonding force of GaSe crystal by doping of Te.

Biography

Yohei Sato has received a Master's degree in Material Sciences from Tohoku University in March 2017. He joined Oyama Laboratory in Sendai, Japan in 2015. Since then, he has been engaged in research of solution growth of semiconductor and THz wave generation from the grown semiconductor crystal.

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