Growth of high quality rare earth iron garnet single crystals by the flux-Bridgman method

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Rare earth garnet ($R_3Fe_5O_{12}$, RIG) single crystals are the most ideal magneto-optical medium for opticalisolators for wavelength longer than 1.1 mm, which has been commercially used in optical fiber communications [1,2]. However, it is still a great challenge to grow large size RIG single crystals. In this work, high quality $Y_3Fe_5O_{12}$ (YIG) and some rare earth substituted single crystals, like DyIG and TbIG, were successfully grown by the flux-Bridgman method for the first time. The as-grown crystals up to 25 mm in diameter was obtained using optimized flux [3]. The transmittance of YIG crystals is over 75% in the region of 1100-2500 nm. TIG crystals also have good transmittance in the range of 1100-1700 nm, and show typical Tb absorption from 1700 to 2500 nm. Typical Dy^{3+} absorption peaks are also observed around 1070 nm, 1265nm and 1670nm. The optical dispersion of the refractive indices was finely fitted by the Wemple and DiDomenico (WDD) and the Sellmeier models, respectively. The specific Faraday rotations of YIG and $Bi_{0.9}Tb_{2.1}Fe_5O_{12}$ crystals are 185 °/cm and 1250 °/cm at 1550 nm, which are comparable to the commercial RIG crystals grown by LPE method. The present results indicate that flux-Bridgman method shows great potential to grow large size and high-quality RIG magneto-optical crystals. It is also beneficial for the design of high-performance garnet crystals for the application of optical switching and non-reciprocal related devices.

References

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