InGaAs Ternary Bulk Crystal Growth Method Using InGaAs Ternary Source

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Recently, 1.3μm lasers with excellent temperature characteristics have been developed using InGaAs ternary substrates[1,2)]. The $In_xGa_{1-x}As$ (x=0.25〜0.30) ternary bulk crystal is necessary for the laser emission in 1.3μm. We have already reported that an $In_xGa_{1-x}As$ (x〜0.3) single crystal can be grown on an InGaAs seed using the multicomponent zone growth method[3,4)].

In this paper, a new growth method which we developed using an InGaAs ternary source to obtain long $In_xGa_{1-x}As$ (x〜0.3) single crystal is described. Figure 1 shows the new growth method. An InGaAs source, a melt and an InGaAs seed charged in a crucible are positioned in the area where the temperature is graded. The InGaAs supplied into the melt from the InGaAs source is propagated to the solid-liquid interface and an $In_xGa_{1-x}As$ zone crystal grows. The composition of an $In_xGa_{1-x}As$ zone crystal is controlled by the temperature of the solid-liquid interface, which can be kept constant by moving the crucible downward. An InGaAs seed grown on a (100) GaAs seed is obtained using the vertical gradient freeze technique. Improvements of this growth method are two that: (1) No isolation plate inserted between a source and a melt is used. The source supplied into the melt is reduced due to restraining the convection by turning positions of an InGaAs seed and a source upside down. (2) The source material is changed from GaAs to InGaAs, because the use of a GaAs source causes the lack of InAs in the melt. The segregation is large in the InAs-GaAs pseudo-binary system. Therefore, an InGaAs source was produced by quenching an $In_xGa_{1-x}As$ melt (x〜0.3). We found that an $In_xGa_{1-x}As$ zone single crystal starts to grow on an InGaAs seed in this growth method. Figure 2 shows the composition profile of an InGaAs zone crystal in the growth direction. The composition of the InGaAs zone crystal was around 0.27, which is decided as a design parameter of the InGaAs ternary substrates laser. The single crystal region of the zone crystal was about 8mm long. Figure 3 shows the (400) X-ray diffraction rocking curve. The best value of the full width of the half maximum of the X-ray diffraction peak was 20 seconds, which is improved below 1/10 of the conventional value.

References

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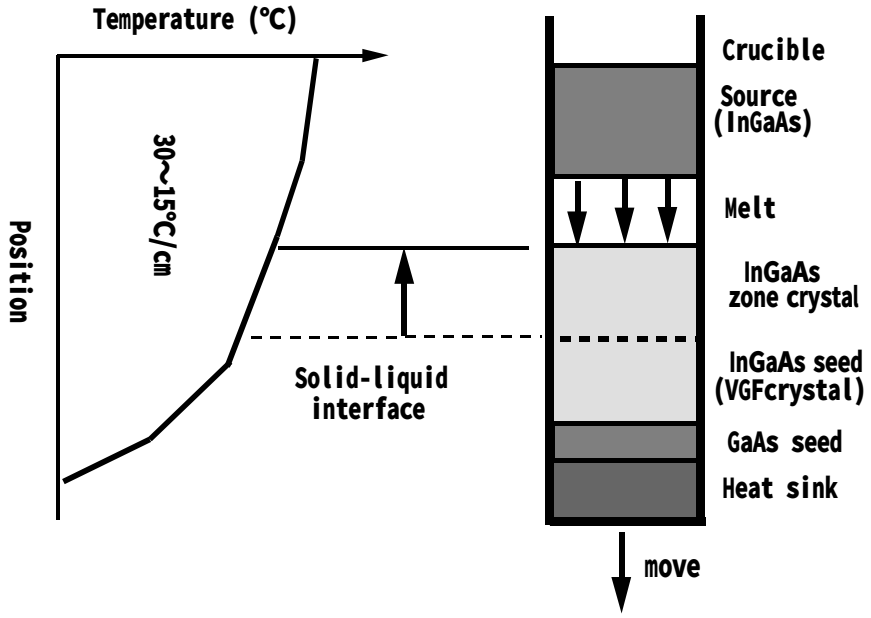

Fig.1 InGaAs crystal growth method

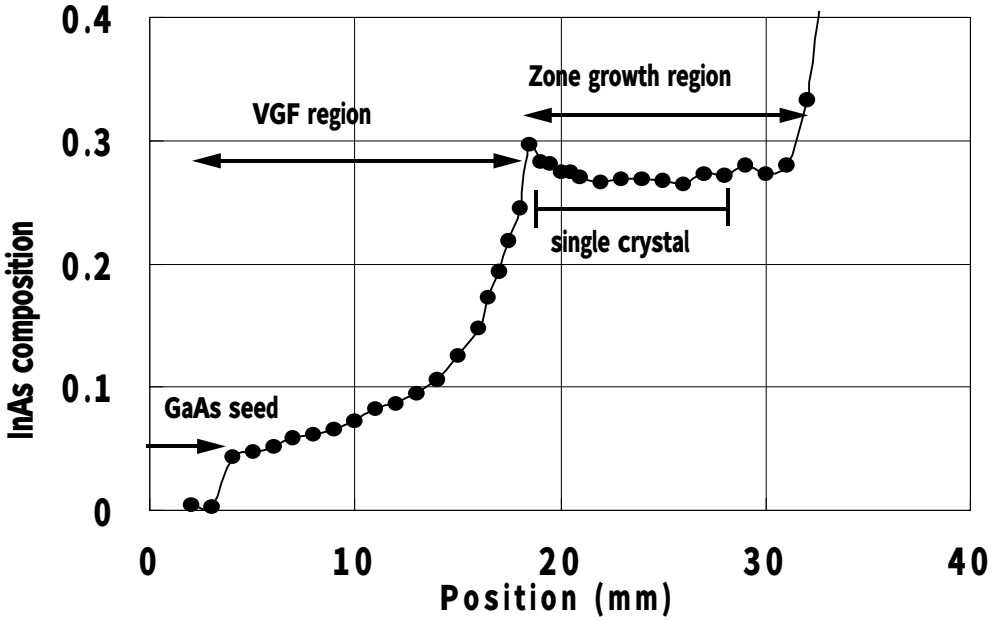

Fig. 2 Compostion profile of InGaAs zone crystal

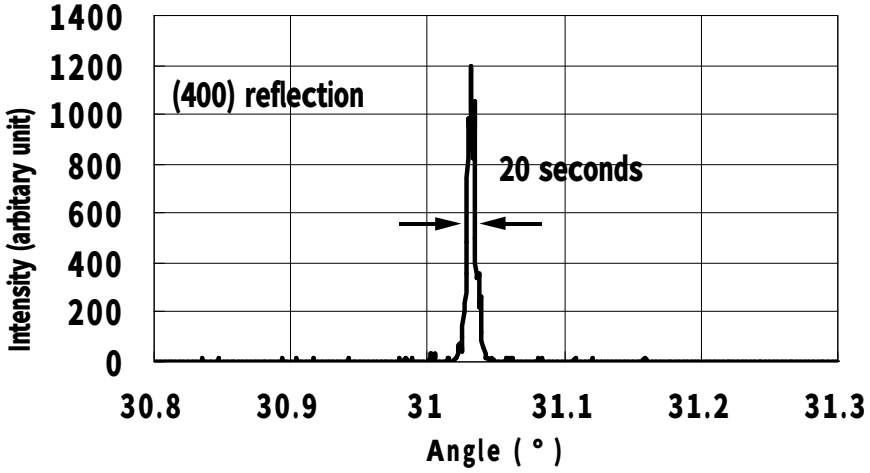

Fig.3 X-ray rocking curve