Crystal Growth of Ⅲ-V Mixed Semiconductors by the Rotary-Bridgman Method

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Ⅲ-V mixed crystals have a feature that the energy gap and the lattice parameter are controllable by changing the composition ratio. However, large mixed crystals of three or more components are very difficult to grow, because (1) the constitutional supercooling is apt to appear in the source solution ahead of the growth interface and (2) both the composition ratio in a grown crystal and that in the solution change simultaneously during crystal growth.

In order to obtain homogeneous and large mixed crystals capable of using as substrates, a rotary-Bridgman method has been developed. What distinguishes this method from the conventional Bridgman method is that the relative motion is given between the crystal and the solution by rotating a growth ampoule at high speed, so as to suppress the appearance of constitutional supercooling.

$InSb_{1-x}Bi_x$ ($x<0.03$) and $In_xGa_{1-x}Sb$ ($x<0.20$) ternary mixed crystals of 10 to 20 mm thick were grown on InSb and GaSb seed crystals, respectively. Further, when a rotary-continuous feeding Bridgman method was employed, homogeneous and large $InSb_{1-x}Bi_x$ mixed crystals were obtained.

$Ga_{1-x}In_xAs_ySb_{1-y}$ quaternary mixed crystals were first grown on GaSb and GaAs seed crystals from the Ga-In-As-Sb solution in the rotary-Bridgman method. As the agitation of the solution due to the ampoule rotation suppressed the occurrence of constitutional supercooling, the maximum thickness of mixed crystal layers reached to about 2.0 mm. These single crystal layers possessed good homogeneity.

It is evident that the rotary-Bridgman method is adequate as a growth method of large mixed crystals.