Growth of InGaSb bulk crystals with uniform composition under microgravity and 1G conditions

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The thesis describes microgravity experiments in an airplane and a drop tower to investigate the crystallization process of InGaSb crystals and the preliminary experiments to grow homogeneous crystals in the international space station (ISS). $In_xGa_{1-x}Sb$ is an optoelectronic device material in the near infrared region. In addition, it is useful for space ventures because of the low melting temperature.

More number of large sized crystals were grown under a reduced gravity condition in an airplane than in the sample prepared under normal gravity. It was due to the reduction of heat convection under reduced gravity. In-situ formation of spherical projections on the surface of InGaSb was observed using a high speed CCD camera in the drop tower experiments. It was found that the shape of projection was influenced by gravity.Since the residual gravity of 10^{-4} - 10^{-5} G range remains in the 53° direction for the furnace in the ISS, the effect of gravitational direction (θ) on the growth has been investigated. The interface was almost flat when θ=0° , and was curved upwards when θ=53° and was curved downward when θ=90° . The decrease of sample diameter and the growth temperature also decreased the distortion of the interface.

Homogeneous $In_xGa_{1-x}Sb$ crystals were grown on GaSb and InSb seeds by cooling the sample at the optimized value estimated from the temperature gradient in the solution and the growth rate. In order to increase the growth length of InGaSb, the optimum InSb length in the GaSb/InSb/GaSb sandwich sample was estimated by the experiments and numerical calculation.

Finally, the experiments in the ISS are proposed based on the data obtained in the preliminary experiments.