New Epitaxial Growth Technology:Melt Epitaxy and Application to Narrow Gap Semiconductors

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In this thesis, we provide a new crystal growth method named melt epitaxy (ME). We grew long wavelength InAsSb, InGaSb, and InNAsSb single crystals by ME, and fabricated long wavelength photo-detectors using InAsSb epilayers.

Chapter 1 provides the purpose of this thesis. In chapter 2, InAsSb/InAsPSb materials for the mid-infrared photoelectric devices and InSbBi epilayers were grown by liquid phase epitaxy (LPE). Chapter 3 describes a new crystal growth technology named melt epitaxy (ME). We present the growth process of ME. The long wavelentgh InAsSb and InGaSb single crystals were grown by ME. We present the improvement of 77 K electron mobility of the InAsSb epilayers by annealing treatment. We grew Ge-doped p-type long wavelength InAsSb epilayers by ME. We prepared InNAsSb single crystals with 300 K cutoff wavelength of 13 μm by ME. From EPMA measurement results, it is clear that the nitrogen was incorporated in the InNAsSb epilayers. In chapter 4, we fabricated InAsSb and InSb detectors. At 77 K, the initial InAsSb detectors can detect the wavelength range up to 9 μm, which is longer than that of InSb detectors. In chapter 5, we discuss the experimental phenomena that were caused by melt epitaxy. The band gap narrowing of InAsSb materials is possibly related to the microscopic composition in-homogeneity of the materials. The summary and conclusion are presented in chapter 6.