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STUDY OF TRANSPORT MECHANISMS OF SILICON IN SIGE MELTS.

Abstract

The transport mechanisms of silicon in silicon-germanium melts have been studied under isothermal conditions and in the Liquid Phase Diffusion (LPD) growth process. SiGe is an important emerging semiconductor material for a variety of applications. The SiGe material system exhibits a large miscibility gap which makes production of bulk material problematic. Full understanding of the material transport mechanisms is necessary in order to optimize the solution growth and melt-replenishment growth processes that are necessary to produce quality bulk material. The transport mechanisms have been observed under a variety of magnetic field conditions. A static field was utilized in the LPD and isothermal studies to suppress thermal convection and highlight the diffusion process. A rotating field and combined static/rotating field was utilized with the LPD process to study enhanced transport. The SiGe system is also subject to strong solutal convection due to the large density difference between the silicon and germanium species. The lighter silicon species tends to float in the germanium solvent altering transport mechanisms. The influence of this has been preliminary examined in the isothermal system. The constraints of ground based experiments allow only for effective diffusion measurements. The solutal buoyancy effect is significant enough to completely change the character of the system depending on system orientation with respect to gravity.