Abstracts

Compensation Mechanism in Liquid Encapsulated Czochralski GaAs: Importance of Melt Stoichiometry

D.E. Holmes, R.T. Chen, K.R. Elliott, C.G. Kirkpatrick and P. Won Yu. "Compensation Mechanism in Liquid Encapsulated Czochralski GaAs: Importance of Melt Stoichiometry." 1982 Transactions on Microwave Theory and Techniques 30.7 (Jul. 1982 [T-MTT] (Joint Special Issue on GaAs IC's)): 949-955.

It is shown that the key to reproducible growth of undoped semi-insulating GaAs by the liquid encapsulated Czochralski (LEC) technique is the control over the melt stoichiometry. Twelve crystals were grown from stoichiometric and nonstoichiometic melts. The material was characterized by secondary ion mass spectrometry, localized vibrational mode far infrared spectroscopy, Hall-effect measurements, optical absorption, and photoluminescence, A quantitative model for the compensation mechanism in the semi-insulating material was developed based on these measurements. The free carrier concentration is controlled by the balance between EL2 deep donors and carbon acceptors; furthermore, the incorporation of EL2 is controlled by the melt stoichiometry, increasing as the As atom fraction in the melt increases. As a result, semi-insulating material can be grown only from melts above a critical As composition. The practical significance of these results is discussed in terms of achieving high yield and reproducibility in the crystal growth process.

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