Atomic Absorption Spectrophotometric Characterization of Cr Impurity in Semi-Insulating GaAs Crystal

Takashi Udagawa

February, 1986

Semi-insulating GaAs crystal is used as substrate material for GaAs microwave devices such as field-effect transistor (FET). The performance of devise is, however, known to be largely depend on substrate quality. It is therefore important to characterize the crystal for improvement in the device performance.

In this study, semi-insulating GaAs was evaluated based on concentration and behavior of Cr impurity in the crystal. For precise analysis of Cr concentration, atomic-absorption spectrophotometry was employed. By optimizing analytical conditions, Cr impurity as low as 2.5×10^{-11}g could be detected. The optimization also permitted to analyze Cr concentration with an accuracy of $\pm0.5\%$ which is much higher than obtained by other physical methods.

The accurate analytical technique also revealed close relation between Cr concentration and leakage current of semi-insulating GaAs. In addition to this, Cr concentration dependence of activation efficiency of an implanted atom was found. The atomic-absorption spectrophotometric technique was then applied to reveal thermal degradation of semi-insulating GaAs during thermal treatment. It was found that the degradation is caused by redistribution of Cr in the crystal. The spectrophotometric technique shows that the Cr redistribution is due to vaporization of a Cr compound from the surface of the crystal. The effect of Cr redistribution on the performance of GaAs FET is also shown.

In conclusion, atomic-absorption spectrophotometry is useful technique to evaluate semi-insulating GaAs crystal, and therefore the improvement of GaAs devices.