Study of the Native Oxide Layer on the Surface of Semiconductor Material GaAs before and after Hot-Implanted Al Ion by RBS/NR Method

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When semiconductor materials are exposed to air, a thin oxide layer known as the native oxide layer grows on their surface. The electrical characteristics and functionality of semiconductor devices are greatly influenced by this native oxide layer. Gallium arsenide (GaAs) is a semiconductor material widely used in electrical and optoelectronic applications. Therefore, studying the formation and growth of the native oxide layer on GaAs surfaces is crucial for improving the performance, reliability, and integration of GaAs-based devices [1]. This work examined the native oxide layer on the GaAs material's surface both before and after hot-implanted aluminum (Al) ions. For the purpose of research, the GaAs samples were subjected to irradiation with 100 keV-Al ions at a fluence of 4×10^{16} ions/cm^2. Ion implantation was performed at temperatures of 25^0 C (room temperature), 300^0 and 500^0 Celsius. Rutherford backscattering spectroscopy with nuclear reaction analysis (RBS/NR) method was used to determine the thickness and atomic composition of elements in the samples [2]. The nuclear reaction $^{16}O(^4He^+,^4He^+)^{16}O$ exhibits elastic resonance at around 3.05 MeV. This resonance provides a useful method for expanding RBS techniques to investigate the concentration of oxygen in oxides [3]. This represents a distinct resonance that exhibits a backscattering cross-section close to the resonance energy, which is up to 25 times larger than the Rutherford cross-section. The RBS/NR approach's conclusion indicates that the surface of GaAs samples contains an oxygen-enriched layer. It has also been demonstrated that when the temperature of the Al-implanted process rises, the thickness of this layer decreases.

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