$CrSi_2$ layer synthesized by high current Cr ion implantation for Schottky diode applications

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Among the transition-metal silicides, $CrSi_2$ has received considerable attention as a material for silicon-based technologies because of its high-temperature stability, oxide-forming ability and semiconducting properties [1]. Its use in infrared photodetectors and Schottky barrier contacts has been of interest. Previous studies indicate that bulk $CrSi_2$ has a hexagonal structure and p-type semiconductor character with a band gap of ≈ 0.35 eV [2].

In this work, we have synthesized and investigated the electrical-structural correlation of $CrSi_2$ buried layer produced by high current Cr ion implantation. For this, Cr^+ ions at an energy of 180 keV were implanted at high temperature (550 °C) at a fluence of $4x10^{17}$ ion/cm^2. An n-type (001) surface-oriented Czochralski Si wafer (thickness 500 mm, resistivity 10-20 Ωcm) was used as host matrix. The chromium beam current density during implantation was about 6 μA/cm^2. The Schottky diode formation consisted of the junction of metal and semiconductor, in this case, Au contact, and the $CrSi_2$/Si, respectively.

The formation of the crystallographic phase was identified by grazing incidence X-ray diffraction. The buried layer morphology of silicide into substrate subsurface was revealed through scanning electron microscopy. Electrical conduction was characterized by resistivity measurements as a function of temperature (50 - 300 K), where two types of regimes are observed, i.e., two gaps: one of low temperature and one of high temperature (270 K). The electronic mobility was also obtained as a function of temperature by means Hall effect measurements. The transport of electrons above the potential barrier to the metal (Schottky barrier height), was determined by current-voltage curves (IxV) at room temperature.

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