Defect and ion distribution studies in ion-implanted silicon

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Ion implantation is one of the most important doping technique in planar technology. During irradiation a lots of defects are created which affect material properties. Positron annihilation techniques allow one to study type and concentrations of the open-volume defects i.e vacancies. The ion projectile range and vacancies depth profiles can be calculated using widely available programs such as SRIM/TRIM. The produced defects mostly occupy the same area as the implanted ones. However, some experiments have shown a much complex damages distribution which is extended much beyond the projectile range.

In current studies the Doppler broadening of the annihilation radiation depth profiling technique was applied to investigate the effect of dose variations in pure silicon. Variable-energy positron beam studies in Ar, N and C ions irradiated silicon have been conducted. Si samples were irradiated with 25 keV ions with doses $2 \cdot 10^{14}$, $2 \cdot 10^{15}$ and $2 \cdot 10^{16}$ cm^{-2}. Ion distribution of C and N implanted samples was obtained using glow-discharge optical emission spectroscopy method. The variation of S parameters show a maximum corresponding to maximum damage calculated with TRIM, but defected zone for highest dose extend far beyond implanted ions indicating on long range effect. Also influence of ion dose on defect concentration was noted.

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