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P96 - Depth profiling of ion-implanted silicon wafer using nuclear resonance of elastic backscattering He + 28Si

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We have studied energy spectra of He-ions backscattered from a silicon wafer implanted with ions. In the He + 28Si scattering, there is a very shape nuclear resonance of 5.374-MeV He with a natural width of 10 keV. Varying incident He energy and considering the energy loss process in Si wafer, we can control He ions to match the resonance energy at the depth of ion implantation. Therefore, scanning over the implantation layer by the sharp resonance, we can analyze a depth profile using the resonance at the base material Si, not implanted ions.

The resonance peaks have been measured by incident He energy from 5.1 to 5.6 MeV with 3 to 15 keV steps at scattering angle of 160°. For the measurements, we have prepared the Si wafers implanted with ions: hydrogen (5x10^17 ions/cm2) at 32 keV, carbon (6.8x10^17 ions/cm2) at 100 keV, and nitrogen (6x10^17 ions/cm2) at 100 keV. These implanted energies are corresponding to a range of about 0.25 micrometer in Si. To avoid axial channeling, the wafers were tilted by 7° from normal incidence.

The envelope of observed resonance peaks shows a depression of the yield caused by the implanted ions, which also indicates a Gaussian shape. Thus, fitting the distribution, we can evaluate the depth profile by parameters such as the center position, the width and the height (yield) of the distribution. The center position indicates a mean depth of implanted ions which means a projected range in Si wafer. The width is a result of the convolution between the resonance peak and a spread of implanted ions which also means a range straggling. The yield at the top of distribution depends on a penetration length of He ions with the resonance energy width, which is affected by the existing of implanted ions or not.

Our method using the nuclear resonance has been demonstrated for silicon wafers implanted with hydrogen, carbon, and nitrogen ions. In the conference, we present the method to evaluate the depth profiling for ion implantation, and also explain the meaning of the depth parameters defined by us. We will show the analyzed result and compare those with the corresponding values of SRIM predictions such as the range and the range straggling.

Primary author: Dr TOSAKI, Mitsuo (Radioisotope Research Center, Kyoto University, Japan)

Co-authors: Dr YASUDA, Keisuke (The Wakasa Wan Energy Research Center, Japan); Dr ISHIGAMI, Ryuya (The Wakasa Wan Energy Research Center, Japan)

Presenter: Dr TOSAKI, Mitsuo (Radioisotope Research Center, Kyoto University, Japan)

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