AN 382
Quantitative Damage Profiles By Ion Channeling

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Discussion

Ion channeling is used to study crystal damage, defect concentration, expitaxial crystal alignment, etc. When an ion beam is aligned along a major crystal axis or plane, ion-atom interaction probability is significantly reduced resulting in a large reduction of scattering events and deeper penetration of ions into the crystal. Simultaneously, redistribution of the ion flux in the channel occurs resulting in a phenomenon called flux-peaking. The ion flux is higher in the center of the channel than near the crystal axis or plane. Consequently, defects which are not located perfectly on the crystal lattice have a larger probability of scattering incoming ions.

In the backscattered spectrum from a channeled sample there are two components: the channeled ions scattered by defects in the crystal, and the de-channeled ions scattered by all atoms in the crystal. This method extracts the component of the channeled ions scattered from the defects and provides a quantitative damage profile in the crystal.

Figure 1 shows the channeling yield raw data plotted versus depth from a Si sample implanted with 1E14 atoms/cm^2 of P. The extracted quantitative damage profile is shown in Figure 2. For comparison the simulated damage profile obtained from a TRIM simulation is shown in Figure 3. The TRIM damage profile shows the total damage (displacement) for all atoms in an amorphous Si sample. The sample shown in Figures 1 and 2 had P implanted in a channeling direction; the real damage profile is shallower than in the simulated amorphous sample.

Other Applications

- Quantitative impurity lattice locations (interstitial or substitutional) in crystal: Li to U by RBS(Rutherford Backscattering), PIXE(Particle Induced X-ray Emission) and NRA (Nuclear Reaction Analysis) with channeling
- Quality of Epitaxial Layer: Defect and Dislocation

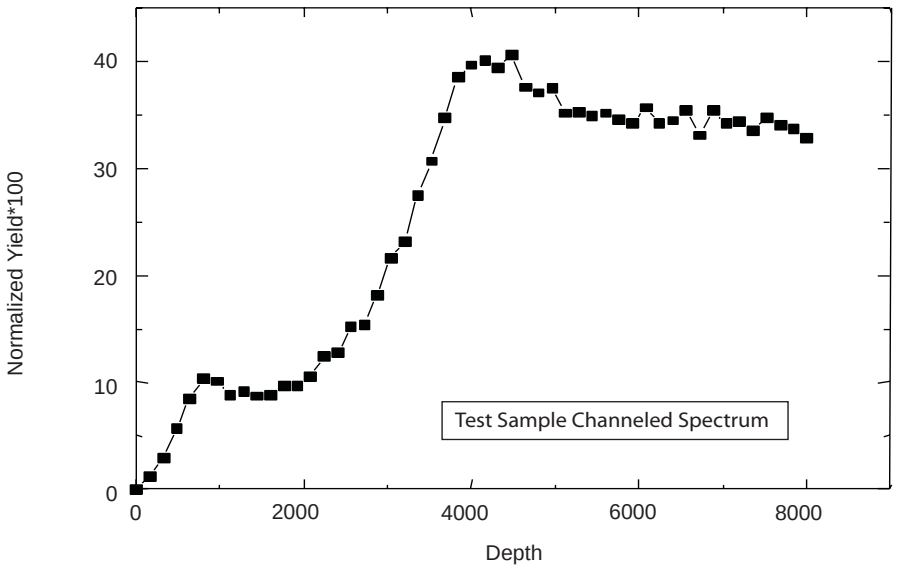

Figure 1. Channeling Yield Raw Data

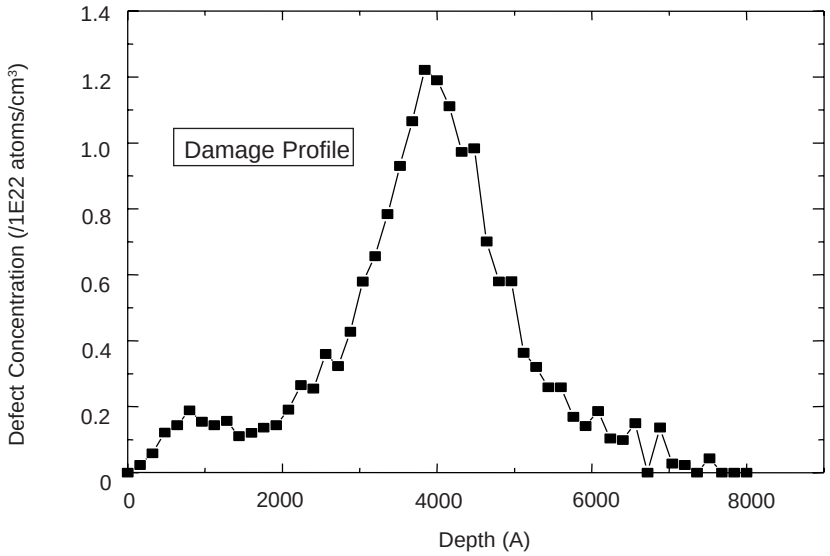

Figure 2. Quantitative Damage Profile

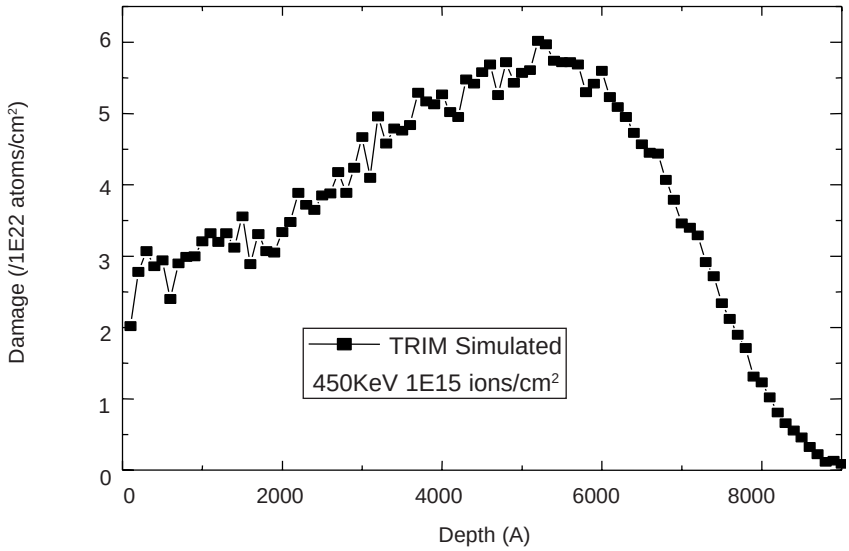

Figure 3. TRIM Simulated Damage Profile in Amorphous Si

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