[III~28]

The structure of the Si – SiO_2 interface formed by oxygen ion beam bombardment and high temperature annealing

Young Pil Kim, Si Kyung Choi
Department of Materials Science and Engineering
Korea Advanced Institute of Science and Technology, Taejon 305-701

Hyung Kyong Kim, Dae Won Moon
Surface Analysis Group
Korea Research Institute of Standards and Science, Taejon 305-606

Since the Si – SiO_2 system has been widely used in semiconductor technology, the structure of its interface is still a controversal issue. One of the questions is a structure of the transirion region, 0.5-3nm, of the interface. The existence of an ordered bulk phase SiO_2(cristobalite or tridymite), a sub-stoichiometric oxide layer and abrupt transition from c-Si to a-SiO_2 has been proposed. However, there are few experimental evidences to clarify the suggestions because it is not easy to probe the interface which is buried below the oxide layer.

For the case of the ion beam oxidation, which is interesting in the field of buried oxide formation etc, the structure of the transition layer would be more complicate.

In our experiment, we investigated the transition region of the Si – SiO_2 interface formed by oxygen ion beam bombardment before and after high temperature annealing and compared them with a thermal oxide which is used in gate oxide.

Medium energy ion scattering(MEIS) analysis with 100keV proton beam was used. MEIS is one of the promising tools to probe surface and interface structure and composition with a depth resolution better than 1nm.

A cleaned Si(001) wafer was bombarded by 3keV O_2^+ beam up to the dose of 5×10^{17}atoms/cm^2 at room temperature and 600°C and annealed at 1200°C in the Ar + 1%O_2 enviornment.

The increase of the silicon peak near the Si – SiO_2 interface dominantly due to the disordered silicon in double aligned energy spectrum disappeared after very short, 15 seconds, annealing at 1200°C. But the width of the transition layers of the ion beam oxide and the thermal oxide estimated from the tailing edge of the silicon peaks are 2.7nm and 2.3nm with respect.

We also observed in the angular profile that the blocking dip was still present at the interface. And the position of the ⟨111⟩ blocking dip, 54.7°-angled from normal direction, was shifted about 0.6° to the normal direction for the room temperature bombardment case.

In this presentation, the structure of the Si – SiO_2 interface will be discussed in detail based on the change of this blocking dips and the double aligned energy spectra for the oxygen ion beam bombardment oxidation and the thermal oxidation, comparatively.