Symposium J: Submission ID 43431 time 9:35 pm, Oct-30-00

BEHAVIOR OF VACANCY CLUSTERS GENERATED BY HIGH-ENERGY ION IMPLANTATION INTO SOI SUBSTRATES

R. Kalyanaraman[1,2], T.E.Haynes[1], H.-J.L.Gossmann[2], G.H.Gilmer[2], and C.S.Rafferty[2].
[1]Solid State Division, Oak Ridge National Laboratory, Oak Ridge, TN.
[2]Bell Laboratories, Lucent Technologies, 600 Mountain Avenue, Murray Hill, NJ.

Following high-energy and/or high-dose ion implantation into silicon, a vacancy-rich region can be observed close to the surface, i.e. in the region often referred to as “0.5R$_{p}$.” During any subsequent thermal treatments, both the interstitials from near R$_{p}$ and the shallower vacancies evolve by ripening, recombining with each other, and annihilating at various sinks. While the energetics and kinetics of interstitial clusters have been widely studied, the vacancy clusters are relatively poorly understood because of the lack of suitable measurement techniques and the ever-present interference from interstitials. Recently, the quantitative study of vacancy defects from high-energy ion implantation in Si has been accelerated due to the development of the Au labeling and microbeam x-ray diffuse scattering measurements, which can directly probe vacancy-type defects. We have recently used these methods to make the first quantitative measurements of the evolution of vacancy profiles in float-zone and epi-Si. In such substrates, the possibility of interference from interstitials near R$_{p}$ remains as a complication.

In this presentation, we report the results of similar new measurements in Si-on-insulator (SOI) substrates where the vacancy-rich region is isolated by the buried oxide from the deeper interstitials. Using isothermal and isochronal measurements, the kinetic and thermodynamic behavior of the vacancy clusters has been studied. In particular, we will compare and discuss the annealing of vacancy clusters in SOI vs. bulk Si. Furthermore, we will discuss additional effects due to implantation through the Si/SiO$_{2}$ interface, which are apparent in the defect profiles following Au-labeling measurements. These experiments with SOI allow us to experimentally isolate effects due to interstitials and provide data on vacancy-reaction kinetics in SOI substrates that will be useful to guide future development of SOI processes.

Oak Ridge National Laboratory, managed by UT-Battelle, LLC, for the U.S. Dept. of Energy under contract DE-AC05-00OR22725.