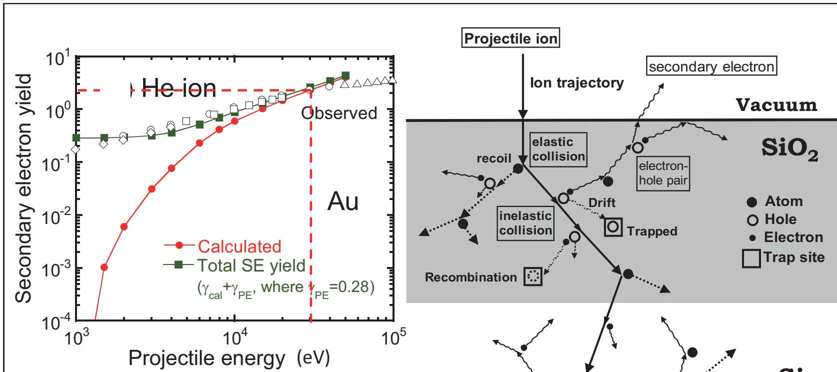
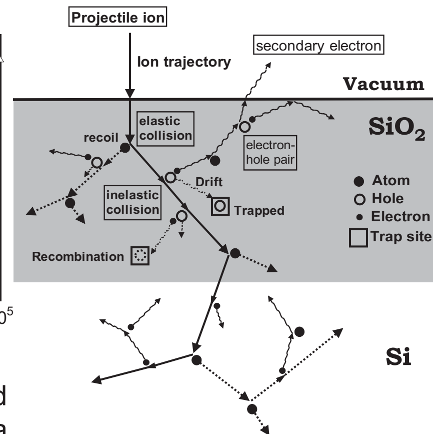
Faculty of Engineering
Tokushima University

Modeling Secondary Electron Image in Helium Ion Microscope

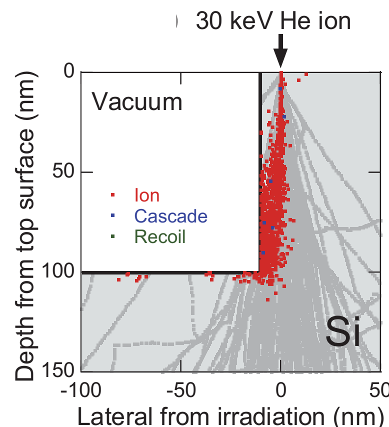
Professor Kaoru Ohya



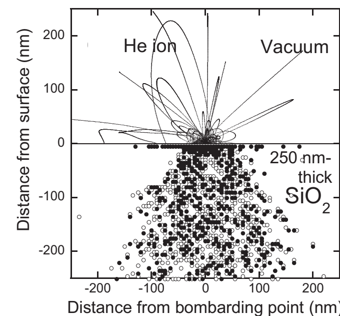
(a) Secondary electron yield from a gold sample as a function of helium ion energy.



(c) Schematic diagram of secondary electron emission and charging of a SiO_2 layer formed on a Si substrate.



(b) Origins of secondary electrons escaped from the step structure irradiated by a helium ion beam.



(d) Charge distribution accumulated in a SiO_2 layer and trajectories of secondary electrons emitted from the surface.

Content:

A scanning ion microscope (SIM) using a gallium (Ga) focused ion beam, like conventional scanning electron microscopes (SEMs), has been used to detect secondary electrons (SEs) emitted from a sample by scanning the ion beam across it, as an observation tool in micro-fabrication processes.

Recently, a SIM using a helium gas field ion source, generally called HIM, has attracted interest for its impressive capability not only to observe nanostructures but also to fabricate them. Although the image formation mechanisms of the HIM are similar to those in the SEM, there are some differences in image properties.

We have performed Monte Carlo simulations of the SE emission in Ga-SIM and HIM to compare with those obtained using SEM. The approach has revealed the theoretical spatial resolution and the origin of the image differences from those in the SEM.

Recent development of the modeling work presents charging characteristics of insulating layers on a conducting substrate and image contrast for nanostructured materials.

Keywords: ion microscope, ion-solid interaction, secondary electron emission, computer simulation

E-mail: ohya@tokushima-u.ac.jp
Tel. +81-88-656-7444
Fax: +81-88-656-7444