Self organized nano dot formation on InP(111) semiconductor surfaces by ion beam irradiation

With the fast growing interest in nanotechnology, fabrication of regular arrays of semiconductor nanostructures with controlled size and height is of great importance. These nanoscale patterns hold promise in applications as varied as optical devices, templates for liquid crystal orientation, and strain-free patterned substrates for hetero-epitaxial growth of quantum dots or wires. Fabrication of nano-dots through self-organization, induced by ion irradiation processes, has attracted special interest due to the possibility of production of regular arrays of dots on large areas in a single technological step. The pattern formation occurs due to the competition between curvature dependant ion sputtering that roughens the surface and it’s smoothening by different relaxation mechanisms. During this patterning, however, along with nano dot fabrication the surface also undergoes structural modifications due to ion irradiation. Although these surface modifications have not received much attention, they are important for understanding the parameters influencing the formation of nano-dots as well as their evolution. Ion irradiation can, however, also lead to modifications in the nature of the surface as well as its stochiometry which can effect the self assembly crucially.
In this thesis, I present the results of investigations on the formation of nano-structures on InP(111) surfaces after low energy (3 keV) Ar ion irradiation and high energy (1.5 MeV) Sb ion irradiation. The thesis discusses the formation of nano-dots, their evolution as a function of fluence, their size and height distributions, related surface modifications as well as the surface exponents. I have primarily utilized the techniques of Scanning Probe Microscopy (SPM), Raman scattering, X-ray Photo-electron Spectroscopy (XPS) and ion beam accelerator for these studies. In addition, I will also present some work in epitaxial Co thin film deposition using molecular beam epitaxy (MBE) techniques and their surface morphology and magnetic property studies.

Reference:


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