Seminar

Institute for Plasma Research

Title : Ion-beam induced nanostructuring of Si: Fundamentals and some applications

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Date : 5th January 2015, Monday

Time : 03.30 PM

Venue : Seminar Hall, IPR

Abstract:

Ion bombardment of solids is an efficient route towards processing of nano-scale surface patterns as well as synthesis and modification of nanostructures. Bombardment of ions with energy varying from a few hundred eV to tens of keV leads to self-organized formation of nanoscale periodic ripple patterns (for oblique ion incidence) or hexagonally arranged dot patterns (for normalion incidence or for a rotating substrate) on semiconductors, insulators, as well as on metals. Periodic ripple patterns, in particular, are receiving increasing interest due to promising applications, e.g., as templates for growth of thin films with tailored properties.Experimental investigation of the patterning process, in conjunction with theoretical models, is necessary for understanding of the underlying mechanisms.

In this talk, I shall present our experimental investigations on the evolution of silicon surface under low energy ion bombardment.Using solid flow model; we have distinguished the linear and nonlinear regime of pattern formation for different incident angles. In addition, a fluence-dependent transition of sinusoidal ripple profile to a faceted one is also observed, which is correlated to non-linear effects and shadowing of the incident beam at high oblique incidences (70^0-77.5^0). On the other hand, the coarsening of the facets occurs due to reflection of primary ions to its neighboring facets. Further, effect of substrate rotation during Ar+-ion-beam irradiation will be highlighted for different incident angles.From the application point of view, some properties of the ion-induced structures, like antireflection and room temperature photoluminescence, will also be discussed. These ion-beam fabricated nanostructures were used as templates for deposition of Al-doped ZnO (AZO) thin films. In particular, I have studied conformal growth of AZO on rippled- and faceted-Si substrates. Photoluminescence studies were done in former case whereas the latter one is preferred for heterojunction solar cell studies. It is observed that that the fill factor of the AZO/faceted-Si heterojunction solar cells can be enhanced by a factor of 2.5 compared to the AZO/pristine-Si case. The observed results will be discussed in terms of improved antireflection property of textures Si substrates.