

Surface nanostructuring of semiconductor and dielectric materials with ions, electrons and photons

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Surface topography modification and nanostructuring could be stimulated either by ballistic processes induced by ion bombardment (all materials), or by inelastic processes induced by ionization and excitation of the electronic system of dielectric and semiconductor materials. Dynamic force microscopy studies revealed that in the first case (ion bombardment) a number of morphologies could be developed due to competition between ballistic sputtering and bombardment enhanced diffusion of atoms in the vicinity or on the top of the surface. The resulting structures vary from ripples, through nanowires up to dots, depending on the materials used, the ion beam parameters, and the surface temperatures. For dielectrics, such as halides, it was shown that inelastic processes induced by electrons and ultraviolet (UV), or X-ray photons could result in surfaces covered by randomly spread rectangular pits of monolayer depth in the topmost layer of the crystal. It was demonstrated that in turn, varying surface topography could affect and modulate periodically the diffusion processes driving the radiation-induced defects from the bulk of the material towards its surface. Furthermore, simultaneous irradiation of the crystal by electrons/UV photons and visible light within the F centre absorption band of the halide crystals could affect both the morphology of the surface and the process efficiency. Such phenomena could be applied in controlled surface nanostructuring. The lecture shall provide a coverage of the above mentioned processes using examples obtained for alkali halide crystals and AIII-BV semiconductors.

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