Laser-Stimulated Processes in Silicon

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Due to intensive development of nanophysics and nanoelectronics the research of electronic phenomena that occur in the optical spectra of surface layers and bulk of functional materials for electronic equipment is important. In recent years laser irradiation very successfully used for surface treatment (surface layers). By use the laser treatment of functional materials for electronic equipment can be change their optical and electrical properties. Study of the laser irradiation is important for the further progress of laser technology.

In this work are shown the results of optical investigations of the reflection spectra in the range 0.2 - 1.7 μm before and after laser irradiation in the energy interval 66 - 108 mJ/cm^2. As semiconductor wafers are used n-Si (100) and n-Si (111) single crystals with a resistivity of 4.5 - 5.5 Om□cm at room temperature. Samples were subjected to laser treatment, namely the crystal surface was uniformly irradiated at room temperature (T = 300 K) pulses of neodymium laser (λ = 532 nm) nanosecond duration (τ = 7-8 ns) of the energy density E from 66 to 108 mJ/cm^2.

So in n-Si single crystals a structural gettering, i.e. the absorption due to the presence of sites with defective structure and have the ability to actively absorb point defects and impurities bind. In silicon the role of getter perform SiO_x, SiO_2, Si_3N_4, $SiO_{2-x}P$, SiC layers and others.

Increasing of the reflectivity of n-Si (100) and n-Si (111) single crystals can be explained as follows: the processing of crystals is modification of thin surface layers and resulting in the total reflection effect contributes thin surface layer and bulk material. Another way this is a result of interference of reflected light (electromagnetic) waves from the boundaries of the air - a thin surface layer and a thin surface layer - the crystal volume. Reflecting the ability of crystals is determined by refractive index n and extinction coefficient χ. Differences of optical characteristics of the surface layer and bulk (complex refractive index of the surface layer $\tilde{n}_s = n_s + i\chi_s$ is different from the complex refractive index of the volume of material $\tilde{n}_v = n_v + i\chi_v$) and leads to the integral effect.

Experimentally shown that high-intensity peak in single crystal n-Si $E_1 = \Lambda_1^c - \Lambda_3^v$, which is located at energy 3.38 eV after laser irradiation increases.

Thus, the laser processing of thin surface layers allows changing the physical properties (optical, electrical and other) functional materials for electronic equipment, which is crucial in the study of fundamental problems of nanostructured systems, nanomaterials and nanotechnology.