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NANOSTRUCTURING OF THE SILICON PLATES SURFACE UNDER THE ACTION OF LASER PULSES

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Modeling surfaces of crystalline solids and processes of their interaction with powerful laser pulses occupy an important place in modern materials science [1–3]. Present study opens great opportunities in both classical and quantum experimentally neglected processes of self-organization of terrain, structural and electronic effects on the surface of condensed systems. Acquisition of functional surficial nano- and microstructures open the possibility of new optical surface properties by particular excitation of surface plasmons suitable to generate plasmon components of electronic circuits, high light absorption, surface crystallography analysis, etc. Experimental studies were carried out on samples of dislocation-free silicon oriented in planes (111), (110) and (100). Along with samples prepared by the conventional method, in particular for the detection of dislocation pits digestion, research was also conducted on the plates obtained by cleavage of crystals in a vacuum in the mechanism VUP-5. Time of freshly cleaved surface presence in a vacuum of 10^{-4} Pa did not exceed 1 s. In addition, a thin (200 Å) amorphous film B_2O_3 was deposited on the surface of the crystals by vacuum to reduce thermal stresses that arise in the areas of laser radiation and leveling of the temperature field. Irradiation of the crystals was carried out evenly across the surface using two types of lasers: continuous CO_2 laser (λ = 10,6 mkm) power of 1 kW, the beam diameter of 3 cm and a pulsed neodymium laser type GOS-300 (λ = 1,06 mkm) that worked in free running mode (T_i=10^{-3} c, q = $10^4 \div 10^5$ Вт/см^2). The experimental studies of geometry features of silicon layers in areas of second and millisecond laser pulses were carried out. The results of microscopic studies of periodic structures that are formed on the surfaces with crystallographic orientation (111) (110) (100) and on planes, cut at an angle of 6° to the plane (100) and amorphous layers B_2O_3 deposited on the surface of silicon were presented. The results can be used to determine the crystallographic orientation of the semiconductor surface and express assessment of disorientation degree of crystal surface.

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НАНОСТРУКТУРУВАННЯ ПОВЕРХНІ КРЕМНІЄВИХ ПЛАСТИН ПРИ ДІЇ ЛАЗЕРНИХ ІМПУЛЬСІВ

Представлені результати експериментальних досліджень процесів мікро- і наноструктурування поверхні кристалічного кремнію в зонах дії секундних і мілісекундних лазерних імпульсів. Наведені результати мікроскопічних досліджень періодичних структур, які формуються на поверхнях з кристалографічною орієнтацією (111), (110), (100), а також на площинах, вирізаних під кутом 6^o до площини (100) і на аморфних шарах B_2O_3, нанесених на поверхню кремнію. Одержані результати можуть бути використані для оптимізації режиму імпульсного лазерного впливу з метою контрольованого наноструктурування поверхні напівпровідників.