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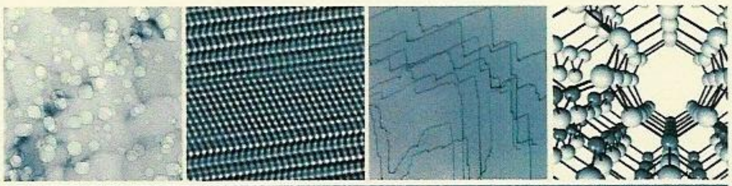

EXTENDED DEFECTS IN SEMICONDUCTORS 2008
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PROGRAM and ABSTRACTS

Dynamics of Nanostructure Formation Using Point Defects in Semiconductors by Laser Radiation

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Dynamics of nanostructures formation, such as nanohills and nanocavities, by powerful strongly absorbed laser radiation is considered in this presentation. Strongly absorbed laser radiation (LR) induces high gradient of temperature in a semiconductor.
Such laser radiation induces high gradient of temperature with maximum at the irradiated surface. As a result, both the rate of point defect generation and their concentration are increased at the irradiated surface with intensity of LR. Moreover, vacancies and interstitial atoms drift in temperature gradient in the opposite directions: vacancies toward the bulk of a semiconductor, but interstitial atoms - toward the irradiated surface, - the so-called Thermogradient effect (TGE). An evidence of this model is p-n junction formation at the surface of p-Si[1], p-InSb[2], p-CdTe[3].
P-n junction formation on a radiated surface of i-Ge and i-InSb single crystal by powerful Nd:YAG laser radiation (wavelength 1.06 μm, power 1MW and pulse duration 15 ns) at low intensity $I< 2.0 MW/cm^2$ have been shown in experiments. This phenomenon is explained by interstitials' and vacancies' spatial redistribution in the gradient temperature field. At high intensity $I \sim 2\text{-}10\ MW/cm^2$ of laser radiation nanohills are formed on the irradiated surface of Si, Ge, SiGe and CdZnTe crystals where observed. Nanocavities were observed in Si single crystal in the bulk after removing the top layer of Si up to 0.1 μm by chemical etching in CP-4 solution. Nanohills formation is explained by presence of mechanical compressive stress due to concentration of interstitial atoms at the irradiated surface, but nanocavities formation – due to joining up of vacancies. Increase of the surface hardness three times after irradiation of Si by the laser at $I=2 MW/cm^2$ has confirmed presence of mechanical compressive stress.

References:
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[3] A.Medvid', Y.Hatanaka, D.Korbutjak, L Fedorenko, Appl.Surf.Sc. **197-198**(2002)124.

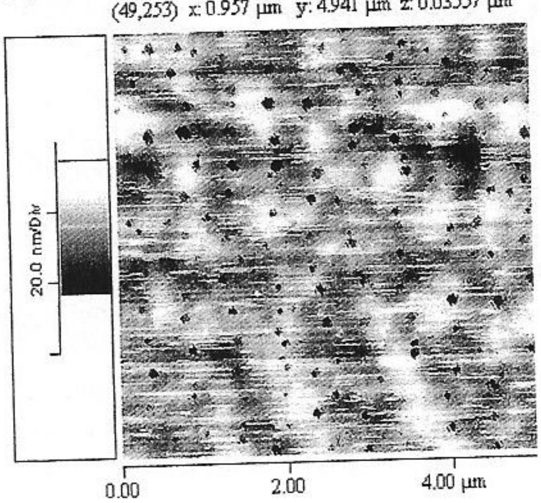

Fig.1. 2D image of Si single crystal surface after irradiation by Nd:YAG laser with I= 2.5 MW/cm and subsequent etching in CP-4. Nanocavities have arisen on the surface with maximal diameter up to 50nm and average distance between nanocavities 0.5 μm.