# Two-Stage Mechanism of Nano-Cones Formation by Laser Radiation on a Surface of Elementary Semiconductors and Semiconductor Solid Solutions

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The basic model used today for description of laser radiation (LR) effects in semiconductors is the thermal model, at least for laser pulse duration till picoseconds [1]. It implies that energy of light is transformed into thermal energy. But it is only the first step in the understanding of this process. So, irradiation of a semiconductor by LR can lead to different results, but sometimes even to opposite results.

Experimental results on investigation of the mechanism of nanocones formation on the irradiated surface of $Si_{1-x}Ge_x$ and $Cd_{1-x}Zn_xTe$ solid solutions have shown that this process is characterized by two stages – Laser Redistribution of Atoms (LRA) and Selective Laser Annealing (SLA).

At the first stage of the process, LRA - formation of hetero-structures takes place, such as: Ge/Si due to Ge and Si atoms separation in $Si_{1-x}Ge_x$ sample and $CdTe/Cd_{1-x1}Zn_{x1}Te$ in $Cd_{1-x0}Zn_{x0}Te$ (x1>x0) solid solutions due to separation of Cd and Zn atoms in gradient of temperature takes place. LRA is non linear optical effect: concentration of the redistributed atoms (Ge in the case of GeSi and Cd in the case of CdZnTe) increase with number of laser pulses and in the same time- increase absorption coefficient of the formed top layer.

At the second stage, SLA - formation of nanocones on the irradiated surface of a semiconductor takes place by mechanical plastic deformation of the top layer due to relaxation of the mechanical compressive stress arising between these layers due to mismatch of their crystal lattices. SLA occurs due to higher absorption of the laser radiation by the top layer than layer under it.

The evidences of these stages will be presented by experimental investigation of $Si_{1-x}Ge_x$ and $Cd_{1-x}Zn_xTe$ solid solutions irradiated by laser radiation using following methods: microhardness, photoluminescence, Raman back scattering and atomic force microscopy.

## References

[1] D.K. Biegelsen, G.A. Rozgonyi and C.V. Shank, in: Energy Beam-Solid Interactions and Transient Thermal Processing, **35** (Pittsburgh:Mater.Res.Soc., 1985).