# Three-waves interactions of surface defect-deformational waves and their role in selforganization of micro- and nanostructures under laser action on solids

**Diploma thesis abstract**

Selforganization of nano and microstrutures of the surface relief under the action of external energy (laser and ion) beams is considered as an instability of quasistatic surface defect-deformational (DD) waves formed by coupled quasistatic Lamb and Rayleigh acoustic waves and defect concentration waves. It is shown that the dependence of the growth rate of DD waves on the wave number has two maxima that select the periods of two dominant surface relief modulations. Survey of experimental data on formation of surface relief under laser and ion beam irradiation of semiconductors and metals reveals the presence of two-scale surface relief modulation. It is shown that the DD surface instability is described by a closed nonlinear equation of Kuramoto-Sivashinsky (KS) type. The KS equation with coefficients specific for ion sputtering of surface is widely used for the description of formation of ordered surface relief structures under ion beam irradiation of metals and semiconductors. The establishing of the universal DDKS equation supports the supposition that the formation of similar surface relief structures under laser and ion beam irradiation has one and the same underlying DD mechanism. The computer solution of obtained two-dimensional DDKS equation is carried out that corroborates the formation of ordered surface relief structures. In the linear regime of DD instability computer analysis demonstrates the formation of characteristic lamellar surface relief structures that is frequently observed in experiments. In the nonlinear regime formation of square and hexagonal structures occurs.

The three-DD waves interactions are considered for the first time including second and third harmonic generation, wave vector mixing and generation of subharmonics. These DD wave interactions occur due to defect-deformational nonlinearity and are similar to optical and acoustical nonlinear wave interactions. The bimodal spectrum of DD waves excited by irradiation in the linear regime of the DD instability is shown to be enriched by nonlinear three DD waves interactions. Computer processing of experimental data on laser-induced generation of micro and nanostructures of surface relief in metals and semiconductors reveals the presence of the effects of second and third harmonic generation and wave mixing.

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