EXMONAN

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The Quantum Effect on Mass Transfer in the Surface Layer in Stressed Solids

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It is well known that the development of stresses within solids can lead to morphological instabilities at the surface. At flat surface of stressed solids, the five types of pattern are observed: (1) grooves and shafts [1,2]; (2) chaotic shallow ripples; (3) finite lifetime high amplitude waves on the background of shallow ripples; (4) chaotic high amplitude waves (5) periodic structure [3]. The first type of pattern exists at the applied stress $s>s_{el}$ (elastic-diffusion instability [1,2]). Other types of pattern are observed for $s<s_{el}$.

In this paper, a new insight on the origin of the pattern 2-5 types is proposed. A semi-infinite homogeneous isotropic one-component solid under uniaxial stress has been considered. A modified phase field method has been used. Two order parameters have been introduced: first, related to the perturbations of the electronic subsystem and the second described the atomic displacements. The coupled system of differential equations describing the evolution of the system has been obtained. It is shown that for $s<s_{el}$, a planar surface can be unstable with respect to electron density fluctuations (dynamic instability). This instability leads to additional dynamic displacements of atoms and to an additional mass transfer. The found solution reproduces well the observed 2-5 types of pattern.

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