941. Dislocation avalanches and strain bursts in the boards of electronic equipment

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Abstract. Dislocation avalanches and strain bursts in the boards of radio-engineering equipment were investigated. For that purpose a cascade of navigation devices boards was installed on the vibration stand and experiments were performed in the 0.5 – 10 Hz vibration range at 0 – +45 °C temperature. Amplitude method was applied to determine the coordinates of localized sources of acoustic emission and research of mechanical stress in local points of material was performed using axial compression tests on tensile machine. The results indicate the initial increase in tension and relative deformation and further their decrement. The acquired experimental data on acoustic emission reflect the formation of microcracks and the instability of mechanical tension, its avalanche and explosive tendency in the material when the micro volumes of material are torn.

Keywords: dislocation avalanches, stain bursts, boards of electronic equipment.

1. Introduction

Constant mechanical stress at the mounting points of most of the radio-engineering electronic products increases due to exploitation and depends on the work environmental conditions and materials the board is made from, usually composite materials and plastics. During installation of the board and exploitation either in normal or extreme conditions the board is subjected to vibration, temperature and pressure changes resulting in the occurrence of plastic deformations due to movement of lattice dislocations.

In microcrystals that were plastically deformed inner dislocation avalanches influence the occurrence of mechanical stress spike - bursts. Dislocation avalanches is a unique feature that does not depend on the specific properties of material and it cannot be avoided by controlling the path of deformation or other crackling noise phenomena [1], such as Barkhausen noise, that is emitted along the hysteresis loop in ferromagnetics [2] or metalelectrics [3], acoustic emission during fracture [4].

The distribution of mechanical stress during dislocation avalanches and its dependence on microcrystal size can be investigated by combining the three-dimensional simulations of the dynamics of interacting dislocations with statistical analysis of corresponding behavior [5]. Several specific dislocations become geometrically unattached during the same case, which demonstrates the importance of long elastic interactions in the initiation of mechanical stress burst. The avalanche has a strongly anisotropic shape with more than 60 % of the deformation occurring on one of the four equivalent sets of slip planes. The statistical analysis of the avalanche distribution suggests that the fractal dimension of the avalanches is close to two, indicating an effective lamellar shape [6].

The existence of unstable bursts in the plastics due to mechanical stress was found [7, 8]. Dislocation avalanches in the polycrystals are limited by the grain boundaries and this can lead to a noticeable smoothing of deformation. The polymeric composite materials with epoxy matrix are used for navigation devices boards which work in various conditions of radiation and