MATHEMATICAL MODEL OF TRIBOLOGICAL SYSTEM AT THE BOUNDARY LUBRICATION MODE

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In work one of possible approaches to the description of a stick-slip friction mode in a nanotribological system which is observed experimentally is developed. The melting of an ultrathin lubricant film clamped between two atomically smooth surfaces is investigated. The mode of the boundary friction sets in given system, is observed, when the lubricant thickness does not exceed 10 atomic diameters. In that case it is impossible to discus about a liquid or solid state of lubricant as symmetry of a condition is influenced essentially by interaction from rubbing surfaces, therefore discus about liquid-like and solid-like state, which are interpreted as kinetic modes between which there can be first order phase transitions. For the description of phase transitions it is entered kinetic equation in the form of Landau-Khalatnikov with item for the account of additive noises of the basic quantities.

It is considered coordinate and shear velocity of the block fixed between two springs when another block, under that, is under periodical influence in presence of forces of interaction between friction surfaces. It is studied the kinetic equation with which help values of elastic strain and friction force are calculated. Thus stick-slip motion is described. It is shown, that in a wide range of parameters of systems the stick-slip mode of movement is realized. Also are found modes in which motion of the top block not equally influences on the moving of bottom block, such case corresponds to realization in system of memory effects (the result proves to be true experiments). Predicting results of behavior of whole system with increase in temperature, dependences of the maximum values of friction force and elastic stress from temperature, rigidity of a spring and proportionality factor between viscosity of lubricant and a gradient of velocity for different types of lubricants (pseudoplastic, Newtonian and dilatants fluids) are received. Thus the model considers both thermodynamic melting, and melting at increase of shear velocity, and can be generalized for the description of real experiments. Researches allow to explain the effects arising in experiments, and to predict behavior of system at change of external and internal parameters

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