Mathematical Modeling of Irreversible Dynamic Deformation, Micro- and Macrofracture of Materials and Structures

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Thermomechanical processes, which proceed in deformable solids under intensive dynamic loading, consist of mechanical, thermal and structural ones, which correlate themselves. The structural processes involve the formation, motion and interaction of defects in metallic crystals, phase transitions, the breaking of bonds between molecules in polymers, the accumulation of microstructural damages (pores, cracks), etc. Irreversible deformations, zones of adiabatic shear and microfractures are caused by these processes. Dynamic fracture is a complicated multistage process including an appearance, evolution and confluence of microdefects and a formation of embryonic microcracks, pores their grow up to the break-up of a bodies with division into separate parts.

The present work includes new results in the next scopes:

1) Development the thermodynamically correct mathematical models of damageable thermoelastoviscoplastic medium (microfracture), earlier worked in papers [1,2];

2) Numerical investigation of some problems for damageable solids and structures [3-5].

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[3] A.B. Kiselev, V.F. Maksimov, O.V. Nekhaeva, "Numerical modeling of irreversible deforming and fracture processes of structures, сопровождающих impact, explosive and penetration. *Modern Problems of Mathematics and Mechanics. Vol. I. Applied Investigations. Edited by V.V. Alexandrov and V.B. Kudriavchev.* (Moscow: Moscow University Publ., 2009), pp. 276–292.

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[5] A.B. Kiselev, P.P. Zakharov, O.V. Nekhaeva, Mathematically modeling the dynamic processes of irreversible deformation and failure of damageable media. Application to problems of geodynamics, (Vestnik of Lobachevsky State Univ. of Nizhni Novgorod, 2011), No. 4 (2), pp. 459–461.