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Report

Of the Member of the Dissertation Council Dr. Zhu Li on the thesis presented by Selyutina Nina Sergeevna, entitled “Dynamic deformation and fracture of materials based on relaxation models of irreversible deformation” for the degree of Doctor of Physical and Mathematical Sciences in the specialty 1.1.8. Solid mechanics.

The aim of this dissertation is to develop predictive models for the deformation and fracture of materials under extreme impacts. A relaxation model for irreversible deformation of homogeneous and inhomogeneous materials is developed based on a single idea - explicit consideration of the relaxation process (introduction of characteristic relaxation times, relaxation functions) and a study of the mechanical effects of fracture mechanics based on a single idea. Plastic mechanics dependence of deformation of various materials and determination of the modes of influence of structure-time properties of materials on the deformation response of homogeneous and inhomogeneous materials in various quasi-static, dynamic and cyclic modes. The paper has sufficient data, a high level of scientific rigour, a reasonable structural design and well supported arguments. This is an excellent dissertation. However, some suggestions have been made with regard to this dissertation.

1. The logic of the paper is a bit of a mess, at first glance it looks like a study of plastic deformation and creep of metallic materials, but there is also brittle fracture, deformation of composite laminates and dynamic response involved, so the subject matter is unclear, although it all revolves around relaxation modelling.
2. The problems such as estimation of rate of hardening of internal stress, appropriate form of activation energy and the assumptions involved in repeated stress relaxation needs further systematic investigation.
3. It has been demonstrated that typical stress relaxation test is non-isothermal. Hence, the temperature change and the associated thermal strain, however insignificant it might be, should be included for calculation.
4. Predicting durability based on the stress relaxation behaviour of materials is still problematic in terms of prediction accuracy, and the prediction method is relatively crude. So how can the short-term relaxation creep behaviour be linked to long-term durability and then the durability of materials predicted with high accuracy?

5. In the mechanical response analysis of composite layered, the calculation process of internal stresses is mainly based on the linear classical plywood theory, which should take into account the non-linear behaviour of the matrix and deeply analyse the coupling effect between different non-linear responses.

6. Whether this is dimensional inhomogeneity in the microstructure of the material or inhomogeneity in hardness, modulus Is it more favourable to the absorption and digestion of externally applied energy, i.e. the macroscopic manifestation of the mechanical properties of the material at the macro level?

I confirm that dissertation of Selyutina Nina Sergeevna on the topic: “Dynamic deformation and fracture of materials based on relaxation models of irreversible deformation” meets the basic requirements established by Order No. 11181/1 of 19.11.2021 “On the procedure for awarding academic degrees at St. Petersburg State University”, therefore Selyutina Nina Sergeevna deserves the award of the degree of Doctor of Physical and Mathematical Sciences in the specialty 1.1.8. Solid mechanics. Violations of paragraphs 9 and 11 of mentioned Order were not found in the dissertation.



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