

# NON-LINEAR WAVES OF LOCALIZED PLASTIC DEFORMATION IN NANOSTRUCTURED SURFACE LAYERS OF SOLID

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1. Surface layers of a solid are the important functional subsystem controlling deformation development within the bulk of material. Surface layer nanostructuring, their high-energy irradiation or hydrogenation greatly enhance the development of mesoscale of plastic flow such as self-consistent non-crystallographic mesobands along the conjugate direction of maximum tangential stresses, doubled spiral mesobands, closed loops, mesovortexes etc.
2. It was theoretically and experimentally shown, that hierarchy of scale levels of quasi-periodic distribution of normal and tangential stresses appears at the “nanostructured layer - substrate” interface:
  - two-dimensional cellular distribution like chess-board (mesoscale level),
  - univariate wave distribution (macroscale level).Their self-consistency causes the development of multilevel mechanisms of plastic flow within the nanostructured surface layer.
3. Multilevel mechanisms of deformation within the nanostructured surface layer of material series (titanium, armco-iron, low-carbon steel and high-alloyed steels) are investigated under different types of loading (tension, compression, alternating bending) in a wide temperature range.
4. Stochastic two-level model of the development of deformation within the surface layers with regard to their coupling with substrate at mesoscale was worked out. The results of simulation correlate well with appropriate experimental data of the development of plastic flow within the surface layer at mesoscale.
5. Using multilevel approach permits us to develop a fundamentally new method of the material hardening by the formation of the nanostructural surface layer with barrier banded sublayer. Such sublayer increases both the strength of the material and its plasticity. Nanostructuring of surface layer of welded joints greatly increases fatigue life of the materials.

## **Keywords**

Nanostructured surface layers, mesomechanics, nonlinear waves of localized deformation

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