MULTI-FRACTAL ANALYSIS OF QUANTITATIVE SPECIFICATION OF PHENOMENA OF DYNAMIC FAILURE, DISPERSION OF METAL AND FULLY-DEVELOPED TURBULENCE

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The paper contemplates universal attributes of phenomena of dynamic failure and turbulence on the basis of analysis of research results and literature data.

In dynamic failure phenomenon the density of absorbed energy, causing the failure is comparable to crystal lattice energy parameters $E \sim$ fraction eV/atom, in the non-equilibrium state range $t \sim 10^{-6} – 3 \cdot 10^{-10}$ s [1, 2].

Macro-failure, which changes the body connectivity, emerges when reaching the critical density of failure center cascades – a percolation cluster, via a bifurcation cascade. Fully-developed turbulence is a chaotic dynamics, which is related to stochastic instability, transition, for example, via sequence of period doubling bifurcations, via intermittency. [3, 4].

At present a strict mathematically sound theory of phenomenon of dynamic failure of condensed matters and that of turbulence theory are absent, what implies application of scaling ratios and phenomenological approaches for their description.

Spectral singularities of multi-fractal measures are a quantitative characteristics of dynamic failure phenomenon, dispersion of metals and fully-developed turbulence. From physical standpoint one can address spectral singularities $f(\alpha)$ as a quantitative characteristics of non-equilibrium systems during bifurcational transitions' processes.

Basing on the results of design-theoretical studies and analysis of literature data, shown is an analogy of phenomena of metals' dynamic failure and fully-developed turbulence, implying that these processes have similar values of critical indices, and are referred to one universality class.

References

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