Statistical analysis of the hybrid coating film surface structure under HCEB modification

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Self-similar surfaces play the important role in interfaces contacts. Morphologies of these surfaces can appear to be quite different depending on the scale with which they can be observed. It can be shown that concepts like roughness are replaced by exponents that refer not to the roughness, but to the fashion in which the roughness changes when the observation scale itself changes. The self-similarity of surfaces can be produced by the fracture or by the mechanical processing. Surface can be formed as a result of a deposition process, shrink due to erosion or etching, propagate through inhomogeneous media. Fractal dimension of such structures is usually determined by obtaining the photographs taken at various zoom levels, with subsequent application of the photograph at a square grid and numerical analysis.

In proposed work we present the investigation of the self-similar structure of the TiN/Al_2O_3 hybrid coating film surface under high current electron beam (HCEB) modification by numerical methods of scaling analysis. Our calculations are based on the algorithm of multifractal detrended fluctuation analysis (MF-DFA), that differs from the standard box-counting based procedures of the fractal dimension estimation.The standard methodic gives precise results only for deterministic self-similar objects with explicit numerical model, and has a large error when applying to the surface models with discreet range of the coordinates.

As it follows from the obtained results, with the increasing of the beam current density and the corresponded partial melting of the matter, the multifractal spectrum of the surface became narrow as the surface itself became more smooth.