Nanostructured surfaces

Fractal analysis of fracture surfaces of titanium and aluminum modified by the high-current quasirelativistic electron beam irradiation

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The titanium and aluminum plates were irradiated by the hollow high-current electron beam (HCEB) with the energy of 0.35 MeV, impulse duration of 5 μs and the average energy density around 200 J/sm^2 [1,2]. The complex multilayered subsurface structures were formed after the intense e-beam exposure. The corresponding cross-fractures were made in the modified and nonirradiated areas at the room temperature. The fracture surfaces were examined using the scanning electron microscope JEOL JSM-840. The HCEB irradiation resulted in significant refinement of microstructure in the quenched layers for both samples. The fractal character of the grayscale SEM images of the fracture surfaces were statistically analyzed using the arithmetic, geometric and devisor step method on the sliding window with varying size [3]. The calculated distributions of fractal dimensions helped to distinguish the scaling behavior of the grain boundaries and failure cracks that ascertained a shift of the fracture mechanism into preferably brittle after the intense heat load induced by the HCEB impact.

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