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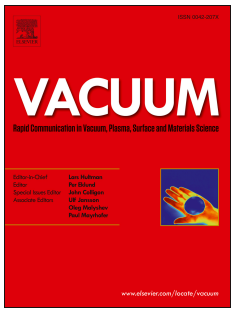

Surface nanocrystallization and gradient microstructural evolutions in the surface layers of 321 stainless steel alloy treated via severe shot peening

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Abstract

The gradient nanocrystalline structure from the top surface to the subsurface layers of 321 austenitic stainless steel alloy was fabricated by means of severe shot peening. The microstructural evolutions including the grain size distribution and phase transformation were investigated in-depth. Experimental results showed that the dislocation slipping plays a key role in the grain refinement of this alloy and depend on the amount of imparted plastic strain, different structures including dislocation walls, dislocation tangles, mechanical twinning, lamella-shaped cells are sequentially appeared in the surface and/or subsurface grains. Due to imparting ultrahigh plastic deformation in the topmost surface, mentioned structures are converted to the nano-grains (68-82 nm) to minimize the total energy of the surface layer. In line with the grain refinement, austenite to strain induced martensite phase transformation is more affected as the plastic strain increases so that the volume fraction of latter phase reaches to 65% in the topmost surface. As a result of these evolutions, microhardness values are decreased from 281 to 120 HV in the surface layers.