Positron annihilation spectroscopy study of gradient microstructure in surface mechanical attrition treated titanium

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High strength, low density, and excellent corrosion resistance are the main attributes that make titanium attractive for a wide variety of applications in such areas as aerospace, automotive, power generation, chemical processing, implants and biomedical devices. However, coarse-grained Ti has for example low wear and abrasion resistance. Nanocrystalline materials exhibits many novel properties in comparison to their coarse counterparts. Surface mechanical attrition treatment (SMAT) is an effective tool to produce nanostructured surface layers which may effectively enhance the overall properties of materials. During SMAT, the gradient microstructure forms due to variation of the strain and strain rate from the treated top surface, where both are large, to the matrix material, where they are essentially zero.

Positron annihilation lifetime spectroscopy (PALS) was applied to study of crystal lattice defects induced by SMAT in commercial purity titanium (Cp-Ti). Two lifetime components corresponding to annihilation of positrons in dislocations and clusters of 3-4 vacancies were resolved and their amounts change with the distance from the treated surface.

The (PALS) results were correlated with the microhardness measurements and electron backscatter diffraction (EBSD) analysis.

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