Residual Stress Distribution Near HA Coating Interface on Titanium Alloy Substrate

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Titanium alloys (Ti-6Al-4V) are largely used to realise fixed and mobile biomechanical prostheses, to be implanted for long times insides the human body, such as dental implants and hip prostheses. In order to prevent damage due to the relevant mechanical stresses and corrosive environment inside the human body, coatings are usually applied to provide a surface with properties such a good biocompatibility, corrosion protection, wear resistance, high strength and low cost. Hydroxyapatite (HA, $Ca_{10}(PO_4)_6(OH)_2$), as the major mineral component of bones and teeth, is used in implants as a coating, obtained by vacuum plasma spray deposition process. Although it has excellent bioactivity HA has poor intrinsic mechanical properties, so it is often coated on metallic substrates. This creates a device that combines good surface bioactivity with the strength of the metallic substrate.

A mechanical characterisation of the HA, coated on Ti-6Al-4V substrate is fundamental for the determination of the characteristics that the material provides from a functional point of view. Together the determination of microstructural features, it is very important to evaluate the residual stresses (RS) induced by deposition process, due to the different thermo-physical proprieties of the substrate and coating, as RS strongly influence the wear resistance of the coating. In this paper, X-ray diffraction stress in the ceramic coating and in Ti-6Al-4V substrate are presented and related to other experimentally determined microstructural parameters.

Keywords: TEM characterization, residual stress analysis, x-ray diffraction