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# Influence of Plasma Based Ion Implantation on the martensitic transformations temperatures of NiTi SMA

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## Abstract

The NiTi shape memory alloys (SMA) is a promising material with applications in several areas due its good mechanical properties, shape memory effect and superelasticity. The samples are produced by the process Electron Beam Melting (EBM), with composition Ti50.63wt%Ni. Plasma Based Ion Implantation (PBII) process is an efficient technique for modifying the surfaces of NiTi alloys. For medical applications, it's necessary to reduce or eliminate the nickel ion release, known for its toxic and allergenic effects. For many applications, it is interesting to improve its surface mechanical properties for increasing wear resistance. The NiTi samples were treated by Nitrogen PBII at 550°C (120 and 360 min) and 770°C (120 min) with 16kV high voltage pulses (repetition rate of 200Hz, pulse length of 30 to 40  $\mu$ s). The treated samples were analysed by EDS (Energy Dispersive Spectroscopy), SEM (Scanning Electron Microscopy) and the thickness of treated samples were measured by GDOES (Glow Discharge Optical Spectrometry). The martensitic transformations temperatures were determined using a DSC (Differential Scanning Calorimeter). The EDS analysis show the appearance of N in the specimens treated at high temperatures. GDOES shows that a thin layer (about 20 – 60 nm) of titanium nitride was formed at the surface. The DSC curves for a heating cycles for the reference sample present As (austenite start temperature) at 49.3°C, Ap (peak minimum of the endothermic curve) at 59.3°C and Af (austenite finish temperature) at 70,7°C. The transformation from austenite to martensite begins on cooling, at Ms = 41.3°C. Mp (martensite peak temperature) is detected at 33.0°C and Mf at 21.0°C. The curves obtained by the treated sample presented similar values than the untreated samples. For example the specimens treated at 770°C, during 120 min, has As, Ap and Af equal 30,1°C, 63.6°C and 73.0°C respectively. Ms, Mp and Mf have values 42.6°C, 36.6 and 23.2°C respectively. We can observe that there is not a significantly difference in the transformations temperatures when the NiTi surface alloys are treated by PBII treatments, on the other hand its surface properties are found to significantly increase, especially for high temperature.

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