

Microstructured Coating of TiO₂ on Titanium Grade 2 Generated by Thermal Oxidation to Improve its Hardness

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Titanium is a light metal that has a large number of applications in the area of medicine and engineering, however, in recent years, it has sought ways to extend its durability and improve its mechanical properties through coatings, which can be obtained by different methods, among them thermal oxidation [1]. In this research, the synthesis and characterization of titanium dioxide (TiO₂) obtained by thermal oxidation of titanium grade 2 at temperatures of 650, 750, and 850 °C is presented. Commercially pure grade 2 titanium was used in the form of plates with dimensions of 2x2 cm and 1.5 mm in thickness. The microstructural changes were made by FE-SEM, AFM and Raman Spectroscopy. The microhardness was obtained by means of a Vickers microhardness. The Raman spectra identified the rutile phase centered at 237, 446 and 610 cm⁻¹, with vibration modes 236 cm⁻¹ (broad band), 447 cm⁻¹ (E_g) and 612 cm⁻¹ (A_{1g}) [2]. FE-SEM shows a microstructured morphology from 750 °C and as the temperature increases, the grains increased from 0.59 to 0.87 μm. The Vickers indentation traces were measured in the FE-SEM to evaluate the lowest loads of up to 0.01 Kg-f, finding that the highest hardness value was 15.7 GPa at 750 °C. AFM corroborates the values of the size of the clusters obtained by FE-SEM in a sweep of 10x10 μm with values from 0.55 to 0.95 μm, and it was found that the roughness (RMS) increased compared to the increase in temperature from 0.09 to 0.41 μm.

References:

[1] A. K. Vacuum. 144 (2017) p. 94-100.

[2] M. Lubas, et al., Spectrochimica Acta. 133 (2014) p. 867-871.

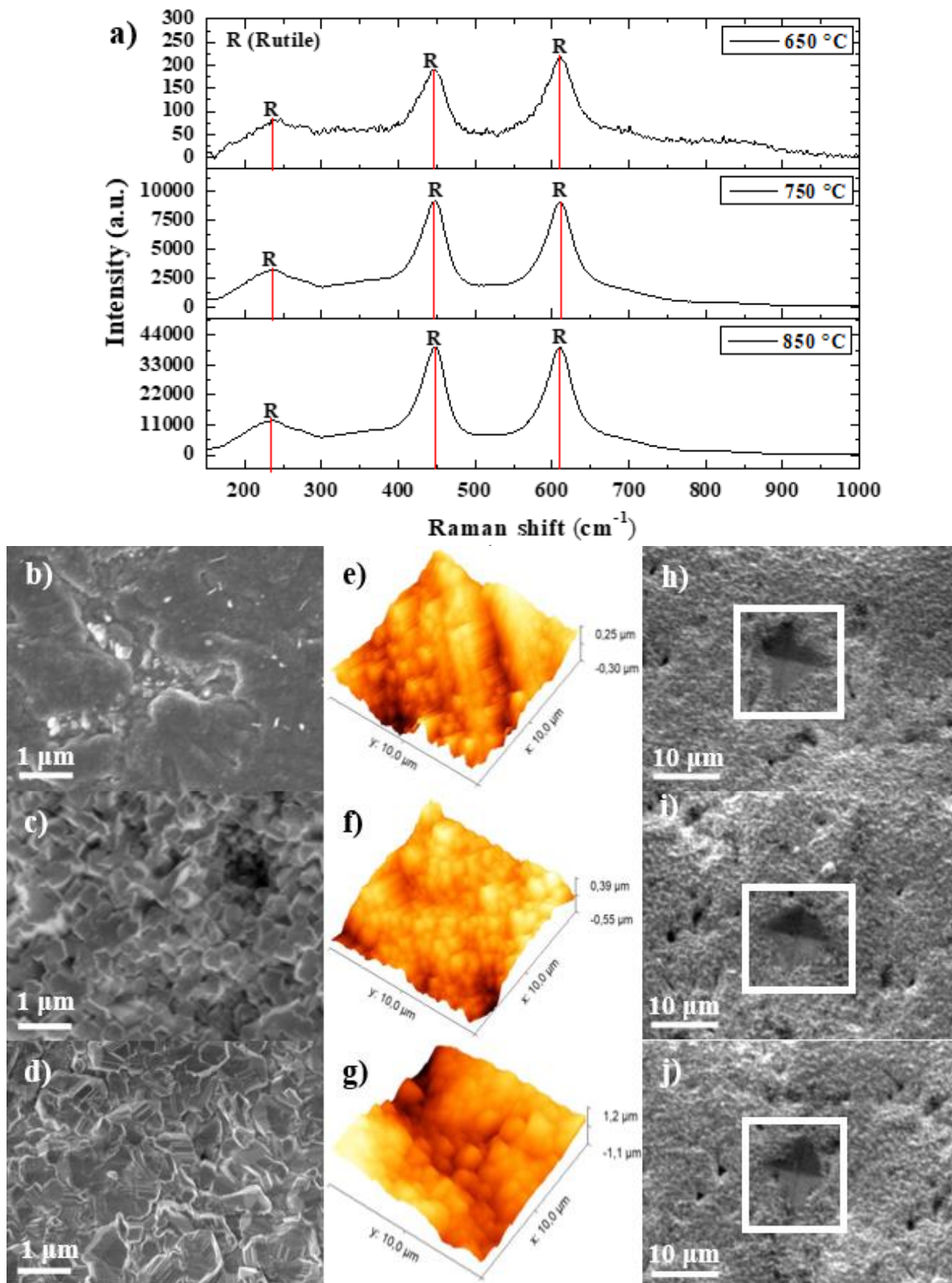


Figure 1. a) Raman spectra of TiO₂. Morphology of TiO₂, b) 650 °C, c) 750 °C and d) 850 °C. Images AFM of TiO₂, e) 650 °C, f) 750 °C and g) 850 °C. Indentation tracks on grade 2 titanium at 750 °C at a load of 0.05 Kg-f (h-j).