

Vacuum firing effect on stainless steel & titanium

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Vacuum firing, which is a heat treatment at high temperature in a high vacuum furnace, is known as the method for the outgassing reduction of the vacuum materials, such as stainless steel, titanium, etc. The outgassing rate of the vacuum-fired stainless steel is known to be low after ordinal baking at 150-200°C. In this research, the effect of the vacuum firing (850°C for 10 h) on the stainless steel and titanium is investigated from the vacuum and surface point of view. The build-up test of the vacuum chambers clearly showed the outgassing suppression by the vacuum firing. Especially, the hydrogen outgassing, which was the main component after baking, was much reduced. Thermal desorption spectroscopy showed that the vacuum firing reduced the desorption of H₂, H₂O, CO, and CO₂ with high desorption energy even after air exposure. Especially the effect on the H₂ was very large. X-ray photoelectron spectroscopy (XPS) showed the increase of ferric oxide and the decrease of chrome oxide on the near surface of the vacuum-fired stainless steel. On the other hand, the XPS also showed that the chrome oxide was systematically increased by heating from 200°C to 400°C. These results support the outgassing reduction mechanism by the vacuum firing that the hydrogen is reduced from the bulk due to the diffusion to the vacuum phase during the vacuum firing and the surface metal oxides are reformed as a diffusion barrier from the gas phase to the bulk. For the titanium, the surface titanium oxide film was once removed by the vacuum firing and the reformed oxide film is thinner. Thus the it is possible that the vacuum fired titanium chamber easily have the getter function by the baking.

Summary

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