ES018

Study of Oxidation Heat Treatment of Reused Co-Cr Dental Ceramo-Metal

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Abstract

The popularity of base metal alloy for porcelain fused to a metal crown and bridges has increased recently because of lower price, superior yield strength and modulus of elasticity (rigidity). Oxidation heat treatment of the metal is used to remove entrapped air, eliminate organic material and form the metal oxidized layer. There is a scarcity of dental scientific literature on the effect of different oxidation heat treatments (OHTs) on the reused of cast cobalt–chromium alloys as surface pretreatments. The objective of this study was to evaluate the effect of different OHTs on the surface morphology and weight change cast reused Co - Cr alloys.

A total of 90 specimens (10.0±0.2 mm X 10.0±0.2 mm X 3.0±0.2 mm) were prepared from reused Co-Cr alloy, according to the ISO 9693 standard. For each OHT method, the specimens were divided into 18 groups: 790°C, 890°C and 980°C for 30s, 60s, 90s, 120s, 150s and 180s. Weight change was examined before and after OHT. The surface morphology and elemental composition were analyzed using a SEM and EDS.

The results of weight change and oxygen concentration were presented in the supplementary oxides on the surface varied according to the different temperature andtime duration in the following order: OHT at 980°C > OHT at 890°C > at 750°C and long duration > short duration.

A micro crystal structure of surface topography was found in 150s, 180s of 790°C group and all duration of 890°C group. The weight change and concentration of oxygen varied with the different temperature and time duration methods. The notice significant microstructure were founded in 150s, 180s of 790°C group and all of 890°C group.

Keywords: Ceramo-metal, Oxidation heat treatment

1. Introduction

Usually, the reused cast of these alloys is processed in dental laboratory procedure. Oxidation heat treatment of the alloy is used to remove entrapped air, eliminate organic material and form the metal oxidized layer. There is a shortage of dental scientific literature on the effect of different oxidation heat treatments (OHT) as surface pretreatments on bond strength of reused base metal alloys and porcelain.

2. Objectives

The objective of this study was to evaluate the effect of different OHT of cast reused Co-Cr alloys on the weight change, surface morphology and bond strength for dental porcelain-fused-to-metal (PFM) systems.

3. Materials and Methods

A total of 2x190 specimens for surface morphology evaluation (15.0±0.2 mm x 15.0±0.2 mm x 3.0±0.1 mm) and bonding test (25±1 mm x 3±0.1 mm x 0.5±0.05 mm) were prepared from reused Co-Cr alloy (Argeloy NP Special, Agribond, Australia) through lost wax technique. For each OHT and testing method, the specimens were separated into 19 groups as shown in Table 1.The weight change was examined earlier and after OHT using analytical balance (262 SMA-FR, Precisa, Switzerland). The OHT and porcelain (VM13, VITA, Germany) procedure were operated using furnace (Vacumat 40 T, VITA, Germany). The surface morphology, elemental composition and oxide thickness were analyzed using a SEM (Quanta 450, FEI, Netherland) and EDS (X-Max, Oxford Instrument, England).The bonding strength was evaluated in flexural strength testing instrument for three point bending and which is capable of attaining a crosshead speed of 1.5±0.5 mm/minute, using a universal testing machine (Instron 4510, UK), according to the ISO 9693-1: 2012.

4. Results

The micro-crystal structure of surface morphology was found in 150s, 180s of 790 °C group and all duration of the 890 °C group as presented in Figure 1. The result of weight gain and oxide thickness were shown in the supplementary oxides on the surface varied according to the different temperature and time duration in the following order: OHT at 980 °C > OHT at 890 °C > OHT at 790 °C and long duration was greater than short duration the highest was the 790-180 group as shown in Figure 3. The oxide thickness evaluation using EDS line-scan as shown in Figure 2.

The weight gain varied with the different temperature and time duration methods. The notice significant microstructure was founded in 150s, 180s of 790°C group and all of 890°C group. The bond strength of control group (39.47 MPa) is greater than the other group. (Figure 4.)

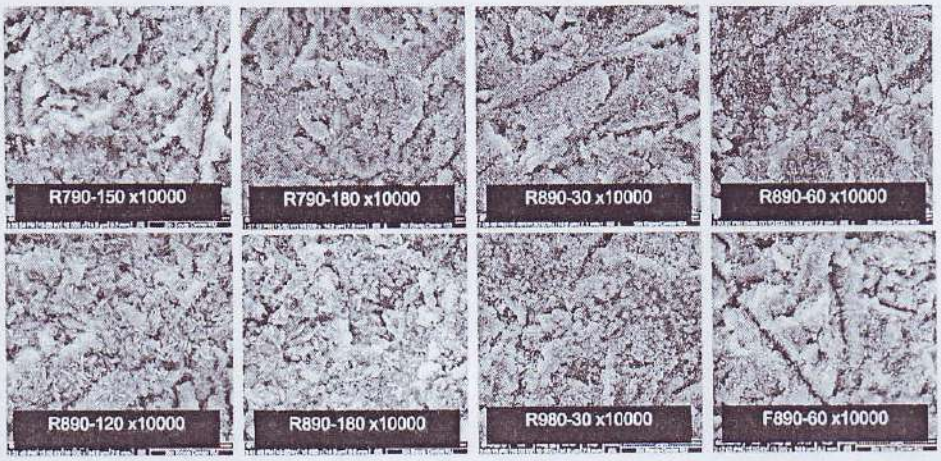

Figure 1. Micro-crystal structure of surface morphology

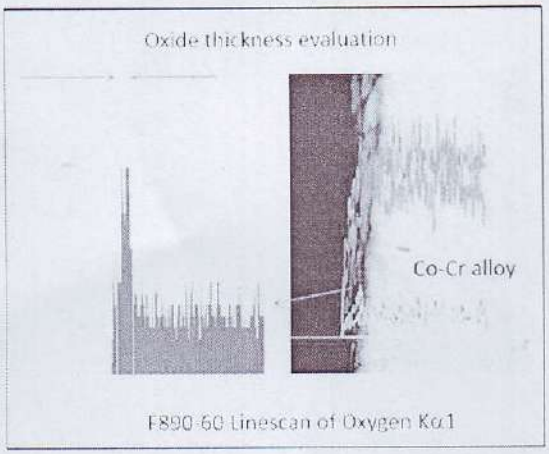

Figure 2. Oxide thickness evaluation.

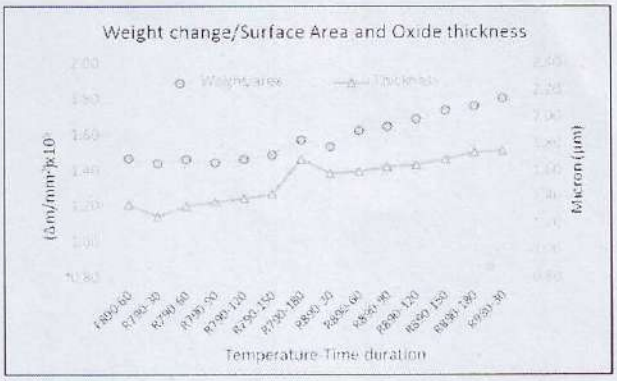

Figure 3. Weight gain per surface area and oxide thickness.

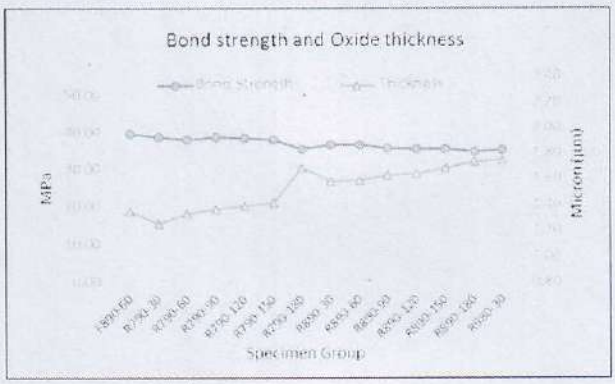

Figure 4. Bond strength and Oxide thickness

5. Discussion

The thermodynamic requirement for the intensity of the surface with metal oxide is the presence of excess metal oxide at all times. (Ritchie et al., 1983). If the oxide layer was completely dissolved away, it would be thermodynamically impossible to maintain the capacity of the interface glassy phase with that oxide. This situation seems to be similar to the experimental procedure. The OHT for experimental alloy is prolonged substantially beyond the ordinary OHT times, the oxide survives largely intact at the alloy interface.

It should be mentioned that the simple presence of an oxide layer at the interface of porcelain and metal strengthen the interface for dental PFM systems. If an oxide layer is lacking to prevent complete dissolution by the fusing porcelain, the porcelain comes into direct contact with the alloy surface, and the adherence is poor.

6. Conclusion

The weight change and concentration of oxygen varied with the different temperature and time duration methods. The notice significant microstructure were founded in 150s, 180s of 790 °C group and all of 890 °C group.

7. Acknowledgement

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8. References

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