Uluslararası Mühendislik Araştırma ve Geliştirme Dergisi
International Journal of Engineering Research and Development
UMAGD, (2020) 12(1), 158-165.
10.29137/umagd.474031
Cilt/Volume:12 Sayı/Issue:1 Ocak/January 2020
Araştırma Makalesi / Research Article

Production and Characterization Of Ti-10Cr-3,33Co-3,33Egg Shelter Composite Materials Using By Powder Metallurgy

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***Başvuru/Received**: 24/10/2018* ***Kabul / Accepted**: 30/07/2019* ***Çevrimiçi Basım / Published Online:** 10/12/2019*
***Son Versiyon/Final Version**: 31/01/2020*

Abstract
Titanium based intermetallic compounds are frequently used in the production of biomaterials. The behavior of titanium similar to bone mechanical properties causes the use of titanium as a biomaterial and preferred among the materials. It also makes its use attractive in industrial applications at high temperatures. TiCrCo intermetallics are known to be used together with Ti matrix materials to improve the properties of the group in addition to elements such as Cr, especially Ti, Co, Mo and Fe in various application areas. This information is used frequently in the sintering process.

In this study, Ti-10Cr-3,33Co-3,33 egg shelter powders were prepared as a sample mixture. When the properties of the samples produced after sintering are examined, it shows the effects of Co on TiCr. 3.33% Co additive was used in the composition of the composition and mechanical properties were determined in the produced samples. By looking at metallographic analysis, structural features were tried to be determined. The density of the produced samples was calculated, hardness and shear strength were determined. According to the results of the analysis, 3.33% Co composition and 3.71 gr / cm^3 density, and 285.5 HV hardness values at 1200 ° C were obtained..

KeyWords
"Sintering, intermetallic, Egg Shelter, Composite, High temperature."

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1. Introduction

In order to ensure sustainability in development, wastes must be recycled. Zero waste standards are a priority in environmental protection (Luengo et al. 2011). Agricultural waste utilization has made contributions to the many aspects of life such as its use as feedstock in the production of biobased products(Abdulrahman et al. 2014). Many agricultural wastes in the vicinity have been reported to be effective raw materials for the production of useful products (Xu et al.,2011;Boonpoke et al. 2013; Rashidi et al., 2012). Many researches on agricultural waste have primarily concerned with the use of energy potentials or its effective use (Ling and Teo, 2012; Surip et al., 2012; Zakaria et al. 2010; Peng et al., 2000). The eggshell is a protective barrier against the penetration of micro-organisms. The shell is a bioceramic composite material formed to protect the egg content (Neves, 1998;Boron 2004). Ceramics are widely used in cutting or cutting tools with high abrasion resistance (Yuhong et al., 2008; Upadhyaya and Bhaumik, 1998; Taheri and Mirhosseini, 2003). Electroless nickel plating is used especially in many industrial applications. The use of electroless nickel plating technique ensures homogeneous Ni distribution on the part to be coated in the bath. It plays an important role in preventing the non-uniform Ni coating in the electrolytic coating. Due to the increase in the sintering temperature of the samples, an increase in the ultrasonic properties except Poisson ratio was observed in both methods (Yönetken et al., 2019).

In the present work, Composites work Ti-10Cr-3,33Co-3,33 egg shelter powders were fabricated, microstructure was characterized, and mechanical properties such as hardness and density were studied. It was observed that the best properties the hardness 197,8 HV were obtained for 1200°C composite.

2. Preparation Of Sample

2.1 Material

Metallic powder properties used in this study are given below. The 99.8% purity and particle size Ti powders less than 70 µm, were obtained from Sigma Aldrich. Cr powders having 99.9% purity and a particle size less than 75 µm from Sigma Aldrich were used. Co powders having 99.8% purity and 2 µm particle size from Sigma Aldrich were used. Composition of Ti-10Cr-3,33Co-3,33 egg powders was prepared. Powder samples were shaped with 10g circular uniaxial press. After weighing, the composition mixture was mixed in a mixer for 24 hours to ensure that the composition was homogeneous. The mixture was shaped by uniaxial cold hydraulic pressing using a high-strength steel mold. It was made under a pressure of 300 bar to compress all powder mixtures. Cold pressed samples were sintered at 900 °C,1000 °C,1100 °C,1200 °C, and 1300 °C for 2 hours in a conventional tube oven using an Argon gas atmosphere. After sintering, the samples were allowed to cool naturally under argon atmosphere in the oven. Micro hardness and shear strength of the samples were measured by METTEST-HT (Vickers) micro hardness tester, respectively. LEO 1430 VP equipped with the Oxford EDX analyzer in TUAM, was used for SEM microstructure and EDX analysis as a scanning electron microscope.

The density changes of the composite samples produced in Ti-10Cr-3,33Co-3,33 egg powders were calculated using the sintering composite samples (d = m / V) formula (Figure 1). The volume of sintered samples was measured by the Archimedes principle. All percentages and ratios were given in percent by weight.

2.2 Experimental Results and Discussion

In this section, the effect of chicken egg powders on the physical and mechanical properties of composite material production is investigated. The results of the samples produced in the study were characterized.

2.3 Characterization of Specimens

The composite samples prepared in the study were sintered in the traditional furnace at 900ºC-1300ºC and made ready for physical, mechanical, and metallographic analyzes. The density-temperature change curve is shown in Figure 1. The highest sintered density is obtained at 3,95g/cm^3 in 1200ºC. The lowest density of the composite samples is obtained as 3.52 g/ cm^3 at 900ºC.

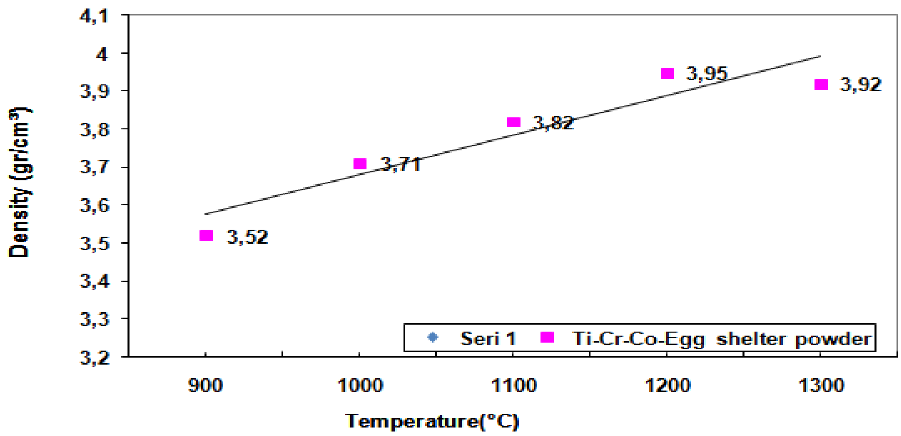

Figure 1. The temperature change with respect to composition at Ti-10Cr-3,33Co-3,33 egg shelter powders.

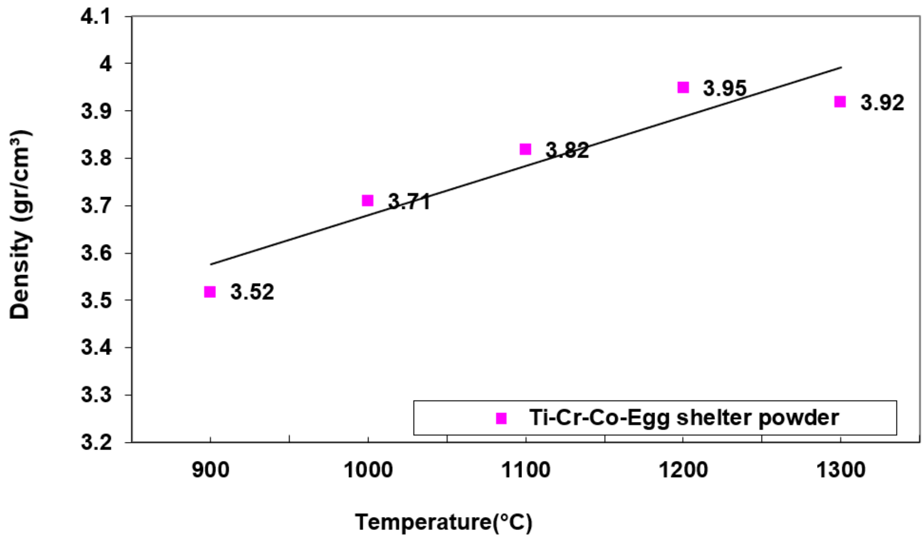

Figure 1 (cont.). The temperature change with respect to composition at Ti-10Cr-3,33Co-3,33 egg shelter powders.

The micro-hardness-temperature change diagram of the composite samples produced is given in Figure 2. Micro hardness values of the composite samples were produced in argon atmosphere using conventional sintering technique at 900ºC-1300ºC. Accordingly, the highest micro hardness value of the composite samples produced by the powder metallurgy method is measured as 197,8HV at 1200 °C.

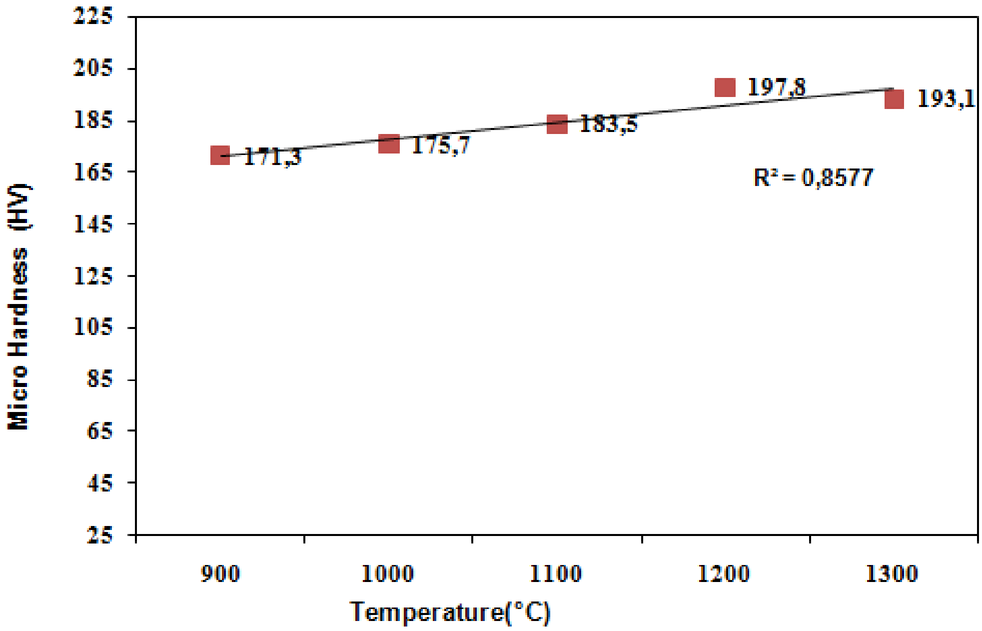

Figure 2. The Micro hardness change with respect to composition at Ti-10Cr-3,33Co-3,33 egg shelter powders.

3. Metallographic Analysis

Fig.3 shows the SEM image of Ti-10Cr-3,33Co-3,33Organic waste composite produced by sintering at 900 °C. Since the sintered sample is sintered at 900 °C, it is seen that the bonding of the particles with the diffusion bond is not realized due to the low sintering temperature.

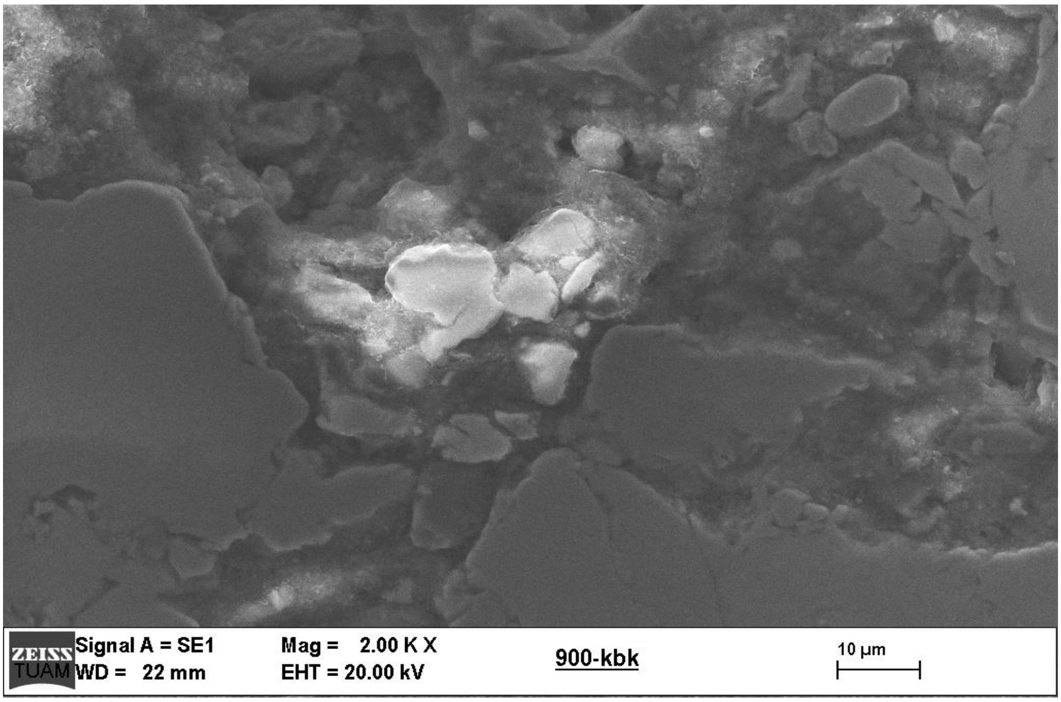

Figure 3. SEM view of Ti-10Cr-3,33Co-3,33 egg shelter composite at 900°C

Figure 4 shows the SEM image of Ti-10Cr-3,33Co-3,33egg shelter composite produced by sintering at 1000 °C. It is understood that a tighter bond between the particles is formed in the sample sintered at 1000 ° C. The picture has been observed. The grain boundaries are not fully formed in the SEM image.

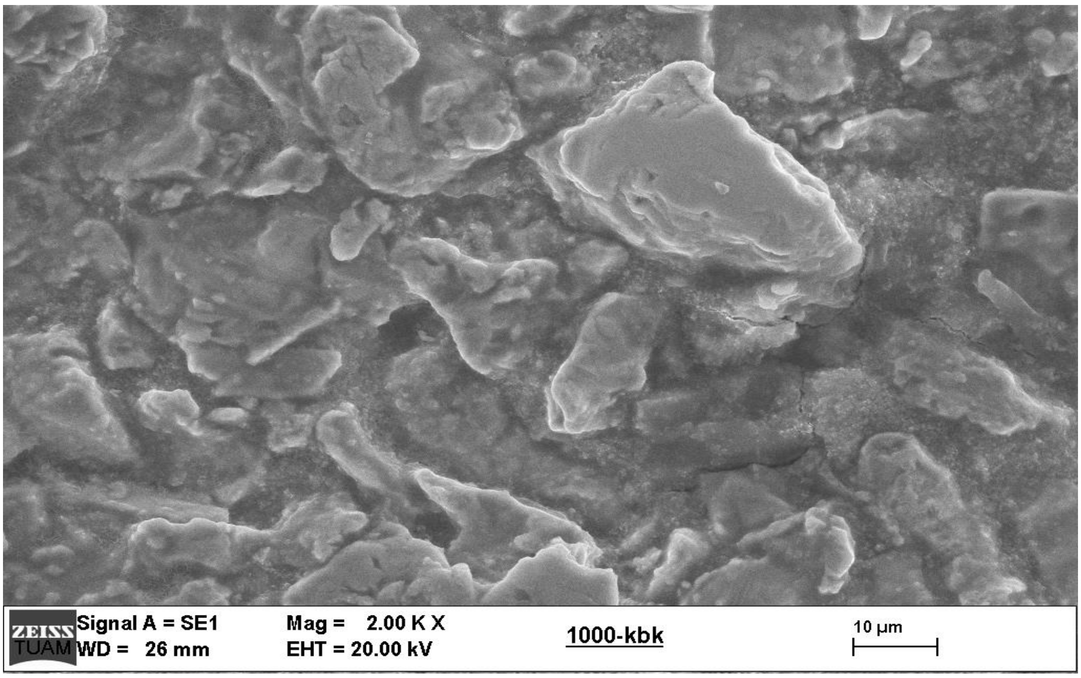

Figure 4. SEM view of Ti-10Cr-3,33Co-3,33egg shelter composite at 1000°C

Fig.5 shows the SEM image of Ti-10Cr-3,33Co-3,33egg shelter composite produced by sintering at 1100 °C. In the sample sintered at 1100 °C, the porosity decreased further at 1000 °C compared to the sintered sample. The grain size and porosity were clearly observed in the SEM analysis image.

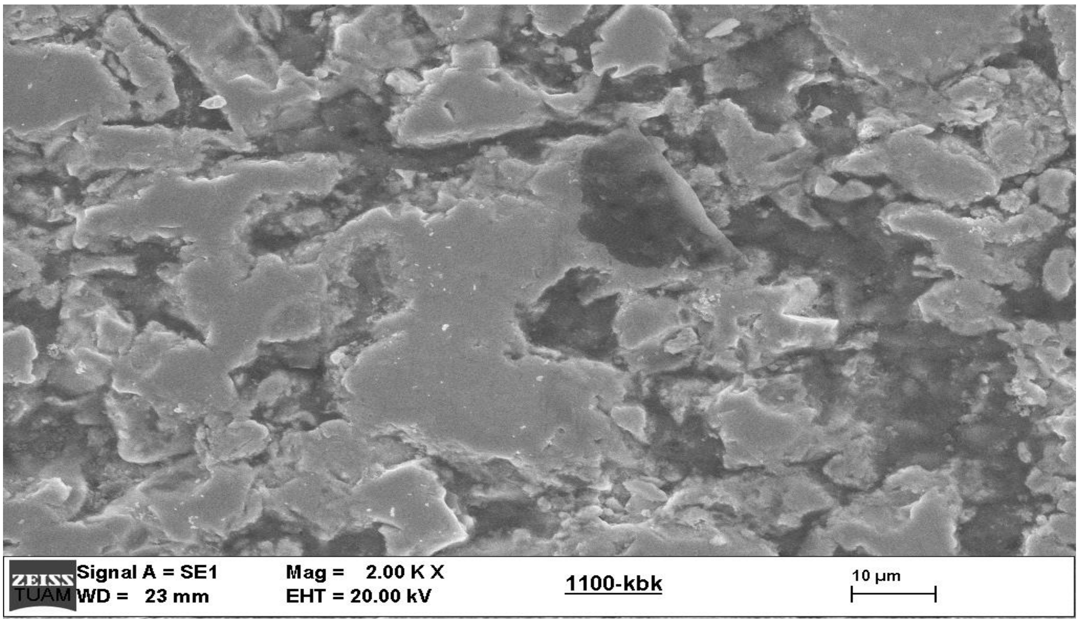

Figure 5. SEM view of Ti-10Cr-3,33Co-3,33egg shelter. composite at 1100°C

Fig. 6 shows the SEM image of Ti-10Cr-3,33Co-3,33egg shelter composite produced by sintering at 1200 °C. In the sample sintered at 1200 °C, the porosity decreases even more at the lower temperatures compared to the sintered samples. The hardness measurements of the specimen produced at 1200 °C confirm the porosity of the hardness increase.

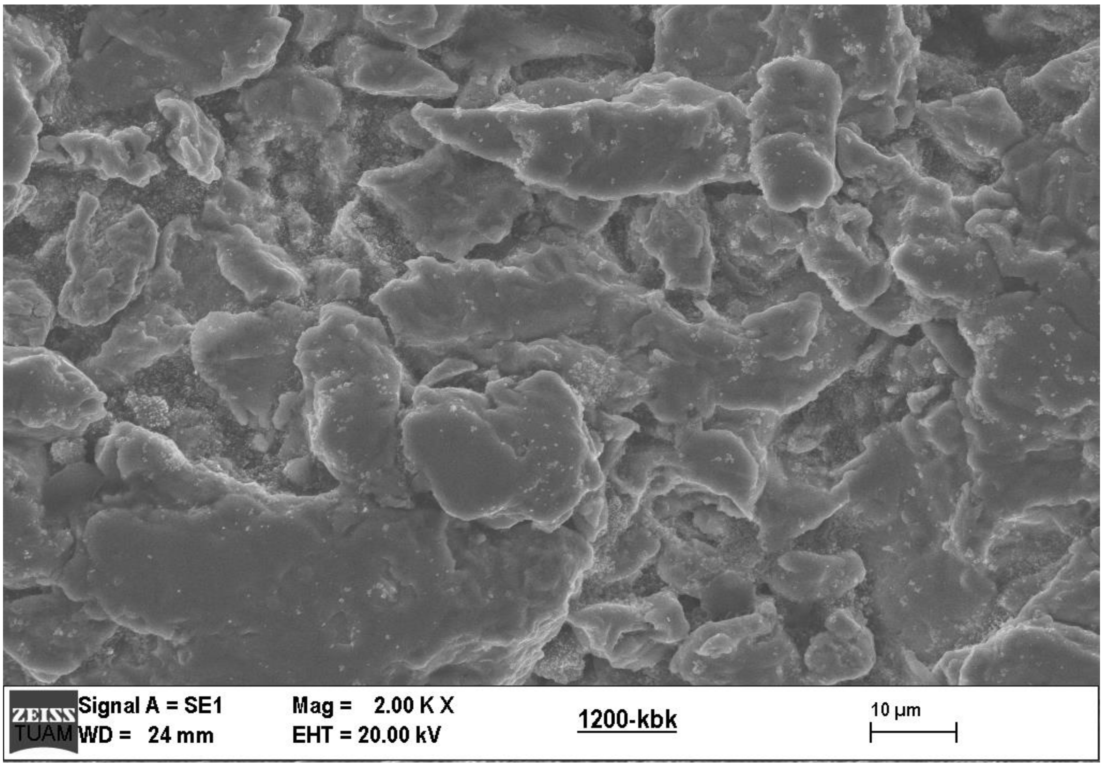

Figure 6. SEM view of Ti-10Cr-3,33Co-3,33egg shelter composite at 1200°C

Figure 7 shows the SEM image of Ti-10Cr-3,33Co-3,33egg shelter composite produced by sintering at 1300 °C. It is seen that the porosity decreases in the sample sintered at 1300 ° C. In hardness measurements, it is observed that the hardness value of the sample produced at 1300 ° C decreased.

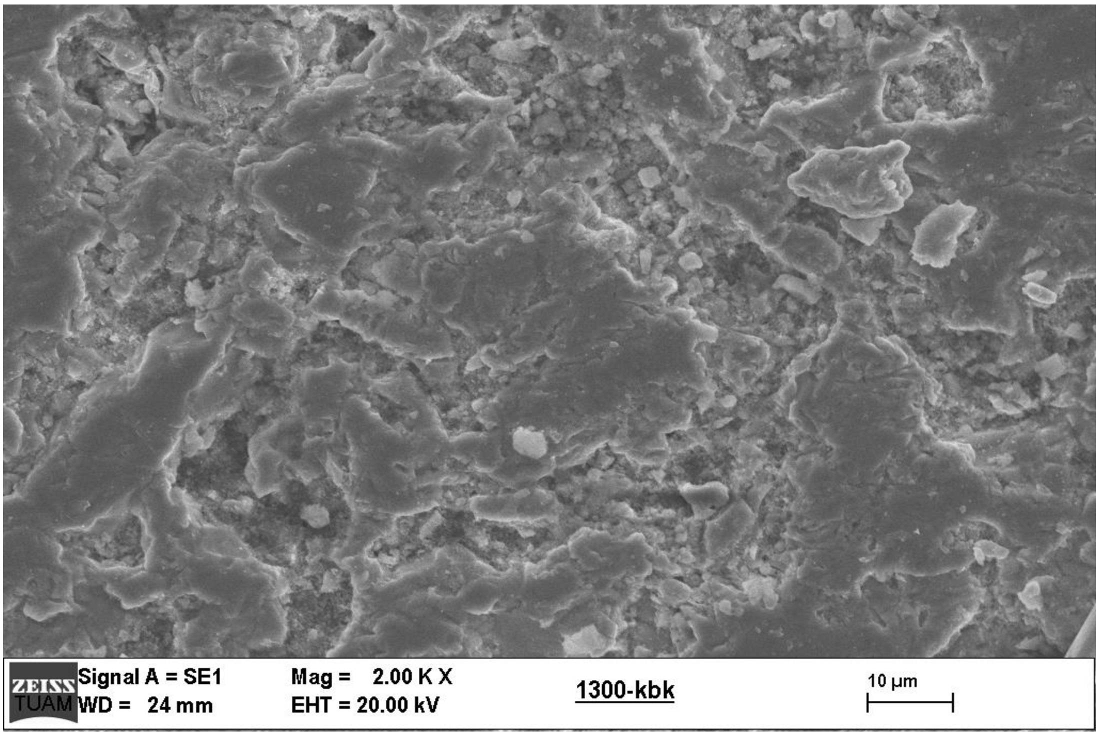

Figure 7. SEM view of Ti-10Cr-3,33Co-3,33egg shelter composite at 1300°C

Ti-10Cr-3,33Co-3,33egg shelter composition specimens were produced by sintering at 900 °C with powder metallurgy. XRD analysis of the composite sample is given. According to the results, Ti, Cr, Co, Cr2Ti, and TiCr phases are determined.

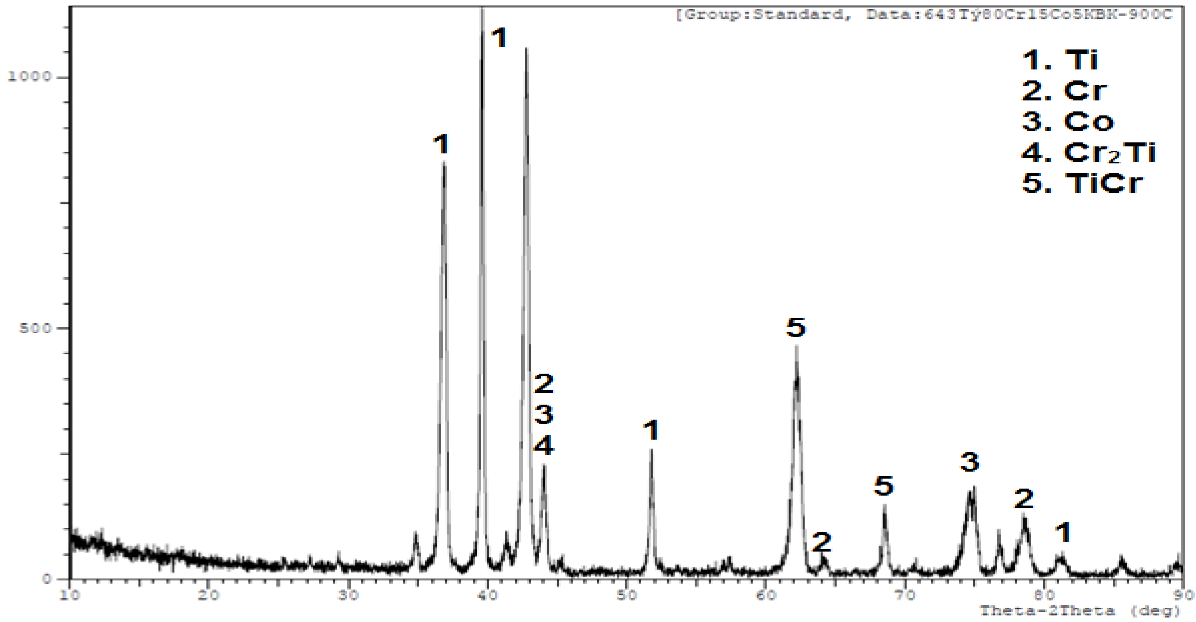

Figure 8. The XRD analysis results of Ti-10Cr-3,33Co-3,33egg shelter. composite at 900°C

Ti-10Cr-3,33Co-3,33egg shelter is produced by sintering at 1300 °C with powder metallurgy. XRD analysis of the composite sample is given. According to the results, Ti, Cr, Co, Cr2Ti, and TiCr phases are formed. It is observed that the same peaks occur at different intensities in the sample produced at 900 °C.

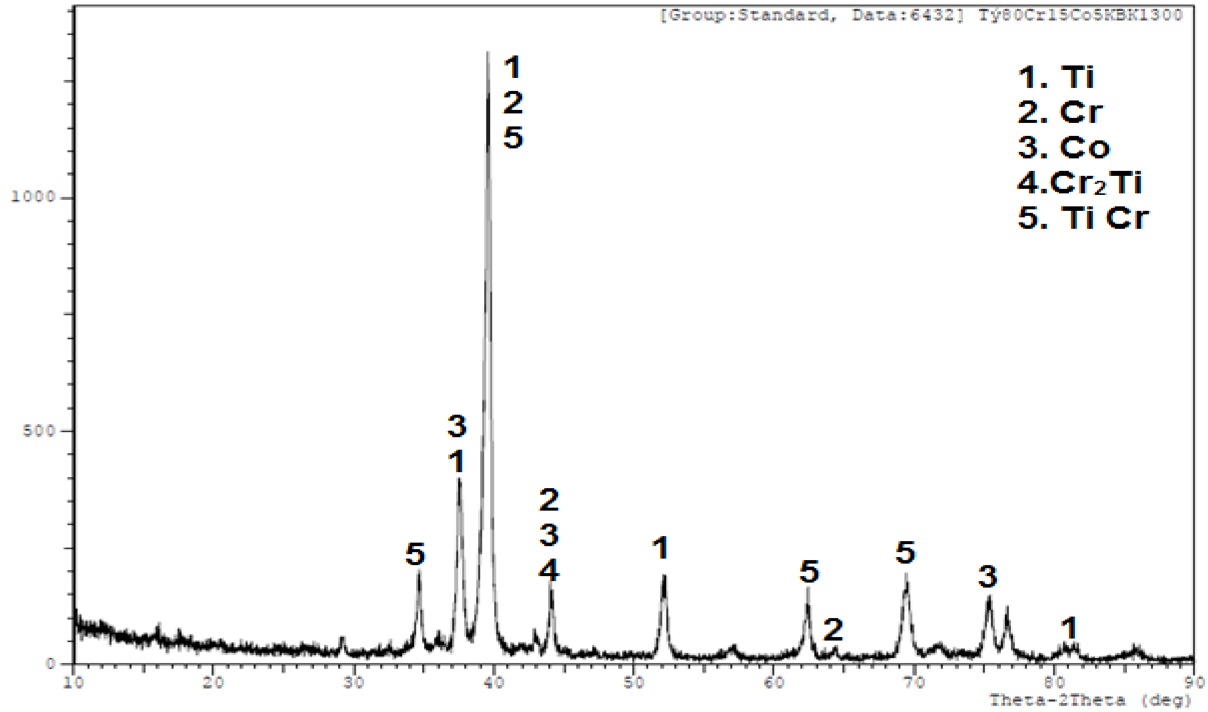

Figure 9. The XRD analysis results of Ti-10Cr-3,33Co-3,33egg shelter. composite at 1300°C

3. Conclusions

Composites produced by electroless nickel plating technique show better mechanical properties besides sintering advantage. It is less porous than composites produced without coating. It is expected to increase corrosion resistance as it is less porous compared to composites produced without coating.

The results obtained from Ti-10Cr-3,33Co-3,33egg shelter composite samples are given below. It was aimed to increase the toughness and decrease the hardness value using eggshell powder in composite production.

•The highest density in composite made from Ti-10Cr-3,33Co-3,33 egg shelter powders sintered at range of 900°C-1300°C temperatures was obtained at 1200°C. The highest density sample was found as 3, 95gr/cm^3 at 1200°C.

•The highest micro hardness was produced using the powder metallurgy method was found as 197,8HV at 1200°C in Ti-10Cr-3,33Co-3,33 egg shelter composite samples.

•It was also found out the best properties at 1200°C in Ti-10Cr-3,33Co-3,33Egg shelter composite. It will be suitable for cutting or plotting tools used in soil industry.

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