Producing Of Cobalt Chromium Molybdenum (CoCrMo) Foam By Replication Method

N. S. A. Manaf [1*], S. Ahmad[1, b], R. Ibrahim [2], Z. Kamdi [1], and A. Ismail[1]
[1]Faculty of Mechanical and Manufacturing Engineering, UTHM, Batu Pahat, Johor, Malaysia
[2]Structural Material Programme, Advanced Materials Centre (AMREC), SIRIM Berhad, Lot 34, Jalan Hi-Tech Park, 09000, Kulim, Kedah, Malaysia

*Email: nursulianiabmanaf@gmail.com

Abstract
Cobalt Chromium Molybdenum (CoCrMo) generally known as a highly resistant to corrosion and wear performance. The aim of this paper is to producing CoCrMo foam that will be given to consider the properties of CoCrMo foam after sintering process. The CoCrMo slurry was produced by mixing CoCrMo powder with Polyethylene Glycol (PEG), Carboxyl Methyl Cellulose (CMC) and distilled water. Then, polymeric foam template was impregnated in CoCrMo slurry and dried at room temperature. Sintering was carried out in a high temperature tube furnace at 1300°C. The microstructure of the CoCrMo foam produced was observed by using Energy Dispersive X-ray Spectroscopy (EDS) and X-Ray Diffraction (XRD). The detected element in CoCrMo foam that was analyse by EDS were Cr, Mo, Co, Mn, C, O, Al, Si and Ca. Then the compound that detected by XRD testing was Cobalt Nitride.

Keywords: Polyurethane, XRD, slurry, microstructure, sintering

Introduction

Metal foams are special class of porous materials with novel physical, mechanical, thermal, electrical and acoustic properties [1]. Metal foam has a unique combination of properties such as air and water permeability, impact energy absorption capacity, unusual acoustic properties, low thermal conductivity, good electrical insulating properties and high stiffness with very low specific weight [3]. Cobalt Chromium Molybdenum generally known as a highly resistant to corrosion and wear performance. CoCrMo alloys for, orthopaedic implants are primarily in the cast or wrought forms, with similar chemical compositions based on American Society for Testing and Materials (ASTM) standards [4]. The wrought Co–Cr–Mo alloys exhibit superior mechanical and chemical properties compared with the cast alloys due to a finer grain size and more homogenous microstructure [5].

Experimental Method

The CoCrMo slurry was prepared by using three different composition of CoCrMo powder which was 65wt%. For the beginning, PEG and CMC were stirred in distilled water. Then, CoCrMo powder was added to the solution and stirred. The PU foams were dipped into the slurry and the dipping and drying processes were repeated until the struts of the foam were completely coated with CoCrMo slurry. The excess slurry was removed by squeezing the foam under a roller. Then PU was removed from the matrix by heating it at 600°C for 60 minutes in the tube furnace. After that, the samples were sintered at 1300°C with holding time of two hours. The rate for heating was 2°C/min. Tube furnace was used for sintering process and sintering process was performed in an argon atmosphere. The microstructure of the sintered foams was characterized using Energy Dispersive X-

ray Spectroscopy (EDS) and X-Ray Diffraction (XRD).

Results & Discussion

Energy Dispersive X-ray Spectroscopy (EDS) was used to provide qualitative information on the elemental composition of the samples after sintering process. Table 1 shows the elemental analysis of the CoCrMo powder and sintered CoCrMo foam using EDS method. Generally, CoCrMo should consist of Co, Cr, Mo, Mn, Ni, C, Ti and Fe. However, the EDS analysis performed in all samples with composition of 65 wt % CoCrMo foam show the presence of of Cr, Mo, Co, Mn, C, O, Al, Si and Ca.

Table 1: The element analysis for CoCrMo powder and CoCrMo Foam after sintered

Element	CoCrMo powder	CoCrMo foam after sintered
Cr	✓	✓
Mo	✓	✓
Ni	✓	
Fe	✓	
C	✓	✓
Si	✓	
Mn	✓	
N	✓	
Ti	✓	
Co	✓	✓
Al		✓
O		✓
Ca		✓

Al and O are the contaminate element which came from alumina powder that was used as sample bed in the crucible during sintering in order to minimize contamination. On the other hand, the Ca element came from the ash of polyurethane foam [6].

Fig. 1 shows the XRD result for CoCrMo powder and CoCrMo foam after sintered. Based on figure, the peak for both pattern remain similar and it is shows that the sample were not oxide [7]. From the XRD results, the pattern that was detected all the peak was PDF 2007: 00-041-0943(Cobalt Nitride). Existence of elements in the CoCrMo foam were further strengthened with the EDS results that had shown in Table 1.

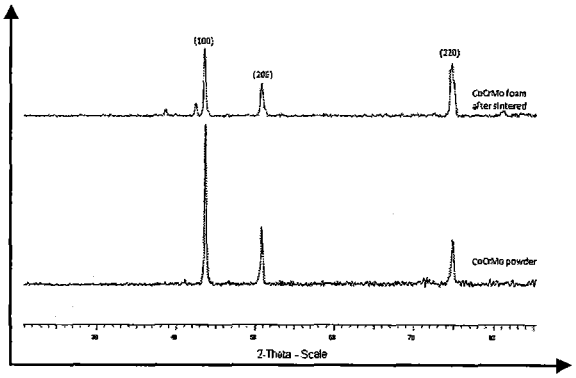

Fig 2: XRD result for CoCrMo powder and CoCrMo foam after sintered in tube furnace

Conclusion

CoCrMo foam that was produced by replication method shows that the sample did not oxide after sintered in 1300°C. The sintering process was found play a critical part in forming the CoCrMo foam.

References

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