Porous Co-Cr Alloy Fabricated by LMD (Liquid Metal Dealloying) Process

Nowadays, Co-Cr alloy has been applied on bio-medical applications such as implants due to its high biocompatibility as well as excellent mechanical properties [1]. Especially, biocompatibility of implant materials can be enhanced drastically if it is processed into porous structure. In this work, we tried to introduce pores on Co-Cr alloy matrix by liquid metal dealloying (LMD) process.

Liquid metal dealloying (LMD) process has received lots of interest nowadays [2]. LMD is a technique to fabricate porous structure by dealloying material with metallic melt instead of chemical etchant. To apply this process, a well-designed alloy system needs to be prepared in consideration of the heat of mixing (ΔH_{mix}) correlation.

To obtain Co-Cr alloy foam, first of all, we choose Ca as metallic melt material of LMD process, since it exhibits not only high biocompatibility, but also bio-degradability. Moreover, we prepared a Co-Cr-Ni ternary alloy as a precursor of LMD process. Here, only Ni shows large negative ΔH_{mix} with Ca. Which means that if we immerse this precursor into Ca melt with high temperature, only Ni is more likely to react and swap its position with Ca.

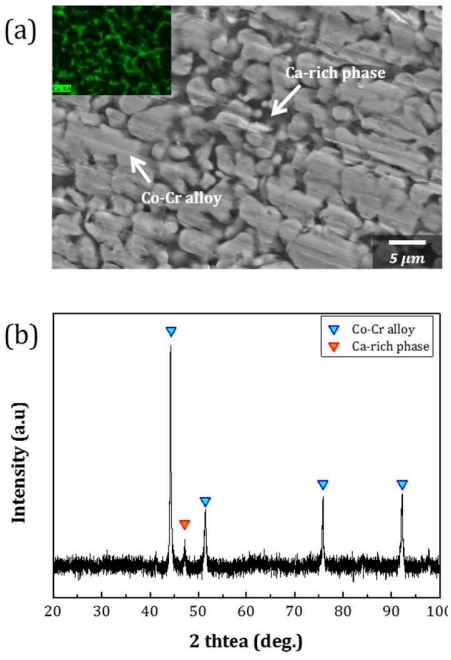

Fig. 1 (a) Microstructure of bi-continuous composite of Ca and Co-Cr alloy fabricated by LMD process and (b) X-ray scan of it.

Fig 1. shows the morphology of the bi-continuous structure of Ca and remained Co-Cr alloy after immersing the precursor in Ca melt. As we can see in EDS mapping image of Ca in (a), Ca is successfully separated with Co-Cr alloy. And this separation behavior can be also found with (b) XRD scan of this composite.

Co-Cr alloy foam was fabricated by leaching all the Ca phase out. Since Ca react with water actively, we immersed this precursor in deionized water for 24 hrs. and cultured osteoblast on Co-Cr alloy with pores.

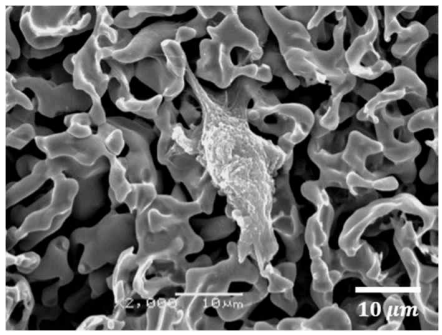

Fig. 2 Cultured cells on porous Co-Cr alloy fabricated by liquid metal dealloying process

As we can see in fig. 2, the Ca-rich phase is successfully dissolved and only Co-Cr alloy ligaments are remained. Moreover, the cells are well attached on each ligament.

Through this research, we fabricated Co-Cr alloy foam which was impossible to be formed by the chemical dealloying process. And we investigated its biocompatibility by attaching osteoblast on the foam. And this attempts will make an important progress of one step forward in bio-medical materials research.

References

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