Experiment No. : 201906073 (1 shift)

BL8S1

X-ray Diffraction study on W-Ni and Steel for 3D printing (Part 1 – W-Ni)

(NSU – Aichi Pref. Joint Research Program)

Jun Ding [1], Osamu Fukuoka[2], Takaaki Murai[2],
Yasushi Uehara[3], Yoshikazu Takeda[3]
[1]Nat. Univ. Singapore, [2]Aich Center for Industry & Sci. Tech., [3]Aichi Synch. Rad. Center

keywords **: X-ray diffraction, Amorphous structure, metallic materials, corrosion resistance**

1. Introduction

Recently, we have prepared amorphous Ni-W samples. Amorphous metal materials have shown many promising properties, including high yielding strength, chemical stability, ferromagnetic behavior etc. The samples have shown interesting properties, such as high hardness and corrosion resistance. The material might have potential in practical applications. In this work, we have studied its microstructure, if it is indeed amorphous.

2. Experiment

Small plate shaped samples were used in the study. Fast scanning was used to check the position, 2θ range, and a rough estimation. After the fast scanning, the samples were measured under parameters for scanning in the ideal 2θ range for an accurate estimation

3. Results and Discussions

As shown in Figure 1, all the samples have shown very similar XRD spectra. There is a very broa peak in the range of 2θ from 30 to 50 degree. The broad peak confirms the amorphous structure [1]. All the samples have shown similar structures, indicating good quality of amorphous structure and uniformity of our samples prepared.

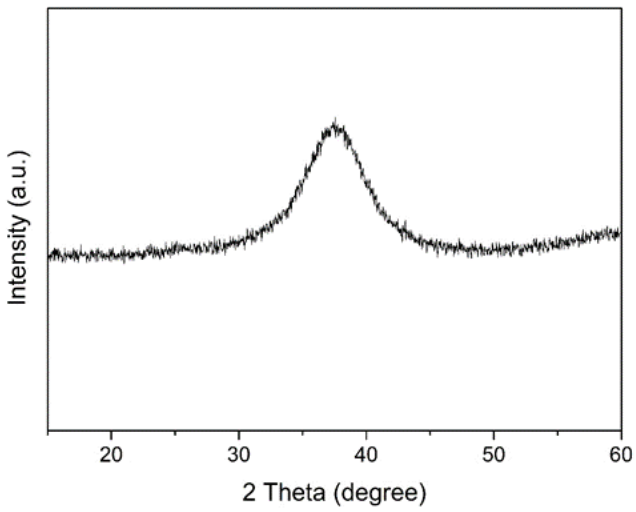

Fig. 1: XRD spectrum of Ni-W alloy

4. References

1. J. Schroers, Acta Mat. 56 (2008) 471.
2. W. L. Johnson, JOM 54 (2002) 40.

Experiment No. : 201906073-2 (1 shift)

BL 8S1

X-ray Diffraction study on W-Ni and Steel for 3D printing (Part 2 – 4340 Steel)

(NSU – Aichi Pref. Joint Research Program)

Jun Ding [1], Osamu Fukuoka[2], Takaaki Murai[2],
Yasushi Uehara[3], Yoshikazu Takeda[3]
[1]Nat. Univ. Singapore, [2]Aich Center for Industry & Sci. Tech., [3]Aichi Synch. Rad. Center

keywords **: X-ray diffraction, Amorphous structure, metallic materials, corrosion resistance**

1. Introduction

Recently, we have used selective laser melting for fabrication of 3D structures. Some interesting results have been obtained, such as high tensile strength of 1600-1700 MPa and good ductility of 12-16 %. In this work, we have used XRD to study their microstructures. The results confirmed that retaining austenite phase was found, accompanied with relatively lower yielding strength. Our further study has shown phase transformation into bcc (or martensite) after mechanical deformation.

2. Experiment

Small plates of 4340 steel were made by wire cutting. XRD was carried out for the two samples. Some unidentified peaks were found. New samples were made by wire cutting followed by chemical etching. A comparison study between before and after chemical etching was done.

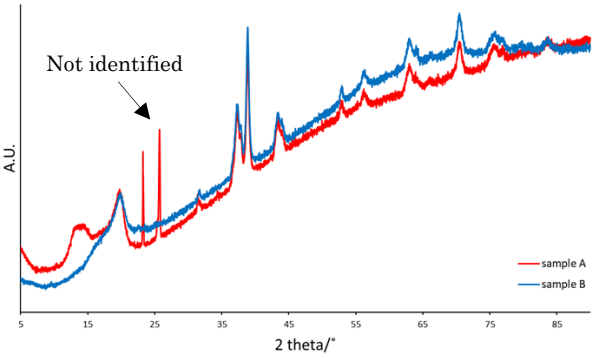

Fig. 2: XRD plots of original data of two samples studied.

3. Results and Discussions

As shown in Figure 2, all the samples have shown very similar XRD spectra measured at AichiSR BL8S1. Both samples have shown a complex structure. A closer study of these peaks at lower angles inciated that these peaks could be due to comtamination during the wire cutting process. After returing Singpaore, we have examined the smaple under SEM. EDAX study showed contamination of Cu (because of copper wire used), Zn, O and C, as shown in Fig. 3. In Fig. 3, we can see that there are two fcc phases, one can be well idnetified as fcc Fe and another one is attributed to fcc Cu. In a separate study, we used chemcial etching to remove the surface. After the chemcial etching, all the XRD peaks below 2θ = 35° disappeared. As hsown in Fig. 3, the XRD pattern after chemical etching can be well idnetified as a mixture of bcc and fcc Fe. A roguh estinaton shows the presence of approximately 10 wt% of fcc Fe, confirming the presence of austenite phase in the as-printed stage.

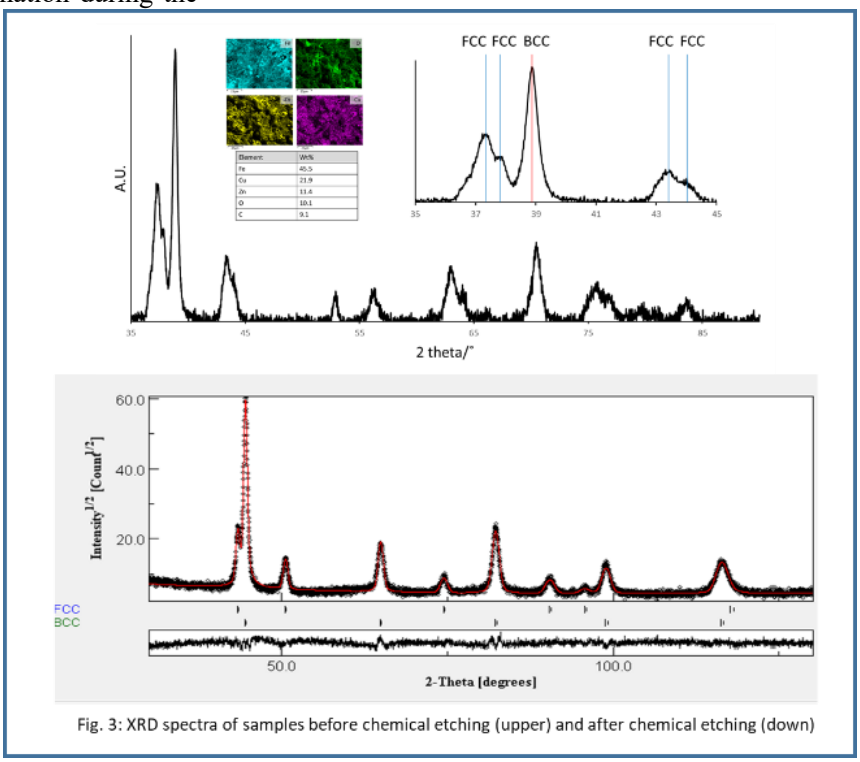

Fig. 3: XRD spectra of samples before chemical etching (upper) and after chemical etching (down)