

# CORROSION RESISTANCE OF ZR-BASED BULK AMORPHOUS ALLOY STUDIED BY USING THE ELECTROCHEMICAL METHOD

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Corrosive behaviors of ZrTiCuNiBe bulk amorphous alloy in several kinds of solutions were studied by using the method of electrochemical corrosion. The results showed that corrosion resistance of ZrTiCuNiBe bulk amorphous alloy in various corrosive solutions is better than that of crystalline alloys.

## 1. Introduction

ZrTiCuNiBe bulk amorphous alloy system is one of the best glass-forming ability so far known [1-6]. It has aroused great interest in the world with its unique mechanical and physical properties. A large number of studies were done for its composition, structure, preparation, transform and properties. However, there have been little data on corrosion resistance of ZrTiCuNiBe bulk amorphous alloy in various corrosive solutions. In this paper, corrosion resistance of ZrTiCuNiBe bulk amorphous alloy in different media was studied by using the method of electrochemical corrosion.

This study provides important reference data to application of ZrTiCuNiBe bulk amorphous alloy in several kinds of corrosive media.

## 2. Experimental method

Two column samples were encapsulated with epoxy resin. ( $\Phi = 16$  mm. One of them was crystallized at the temperature  $400^{\circ}\text{C}$  for two hours.) Only one surface was exposed and burnished until  $1200^{\#}$  sand paper.

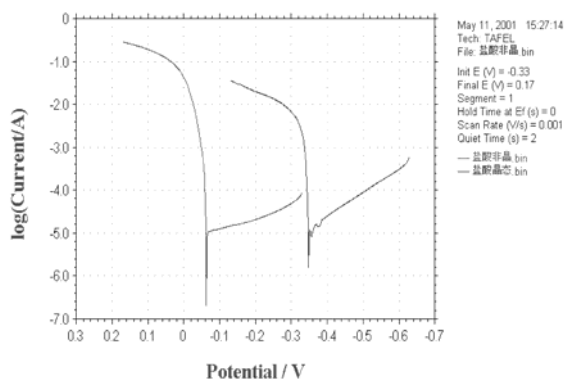


Fig. 1. The polarization curves of two samples in 3mol/l HCl

Electrochemical workstation of CHI 660A was utilized to test the polarization curves of anode and cathode of two samples in the same media. Saturated calomel electrode and platinum electrode were used as reference electrode and auxiliary electrode. Scan scope was from  $-10\text{v}$  to  $+10\text{v}$ . Scan electric current was from  $-250\text{mA}$  to  $+250\text{mA}$ . Scan rate was  $0.001\text{v/s}$ .

## 3. Results and discussion

Fig.1, 2, 3 and 4 are respectively mixture of the polarization curves of two samples in solution of HCl,  $\text{H}_2\text{SO}_4$ , NaOH and NaCl.

Fig.1 and Fig.2 showed the polarization curves of two samples in solutions of 3mol/l HCl and  $\text{H}_2\text{SO}_4$ . (Red curve showed amorphous alloys, blue curve showed crystalline alloys.) Seeing from curves, self-corrosive potential of amorphous alloys moved towards positive direction respectively  $280\text{mv}$  and  $80\text{mv}$  compared with crystalline alloys. As cathode, two samples did not appear absorbing oxygen reaction. As anode, in oxygenized  $\text{H}_2\text{SO}_4$  solution, electrode took place the inactivating phenomenon.

Fig.3 showed the polarization curves of two

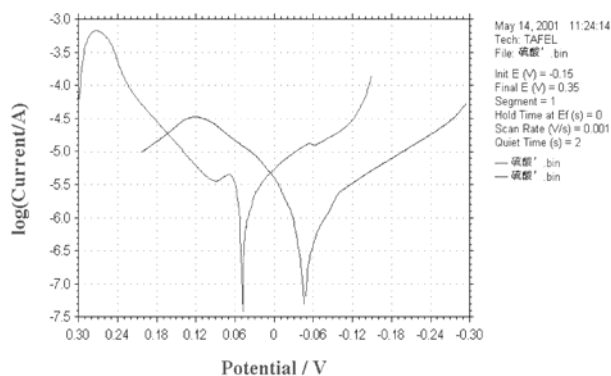


Fig.2. The polarization curves of two samples in 3mol/l  $\text{H}_2\text{SO}_4$

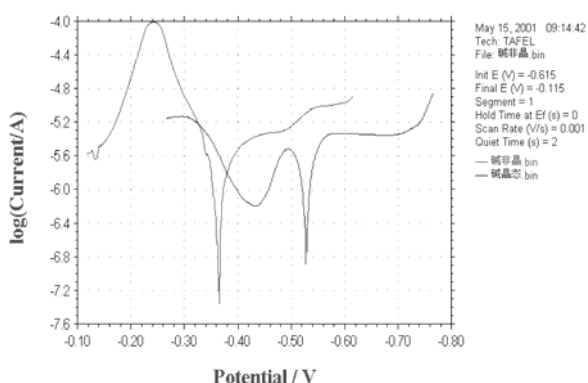


Fig.3. The polarization curves of two samples in 3mol/l NaOH

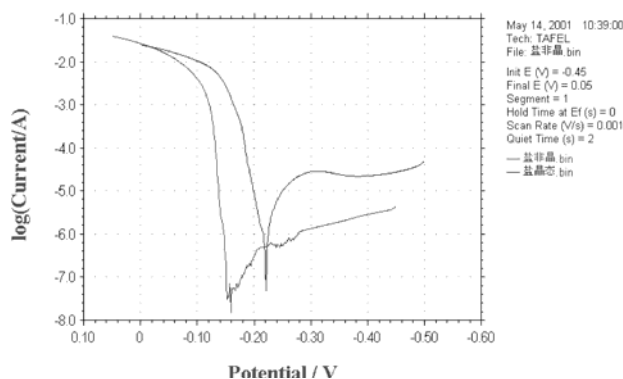


Fig.4. The polarization curves of two samples in 5% NaCl

samples in solution of 3mol/l NaOH. As can be seen, self-corrosive potential of crystalline alloys moved 160mv towards negative direction compared with amorphous alloys. There were platforms in the polarization curves of cathode both amorphous and crystalline alloys. It may be that cathode reaction in this region did not change with potential changing. The electric current density was controlled by diffusion. Two electrodes showed inactivating phenomenon as anode, which indicated two samples exhibit good corrosion resistance. But corrosion resistance of amorphous alloys was better than crystalline alloys because self-corrosive potential of amorphous alloys was higher.

Fig.4 showed the polarization curves of two samples in solution of 5% NaCl. Self-corrosive potential of crystalline alloys moved 60mv towards negative direction compared with amorphous alloys. There was a platform in the polarization curves of cathode of amorphous alloys while there

was no platform of crystalline alloys. Inactivating phenomenon did not appear as anode.

The above analysis showed in the same media, self-corrosive potential of crystalline alloys moved towards negative direction compared with amorphous alloys. Because two samples had the same composition and it can be believed that electrode reaction in cathode polarization region had little relation to structure. So, as cathode, electrode reactions of amorphous and crystalline alloys were almost same. Then, the reason that amorphous alloys had higher self-corrosive potential may be that its low polarization reaction activation led to the big slope of the polarization curves of anode in various kinds of solutions. However, their polarization curves of cathode had little difference. Hence self-corrosive electric current density of amorphous alloys was smaller than that of crystalline alloys. Seeing Fig.5.

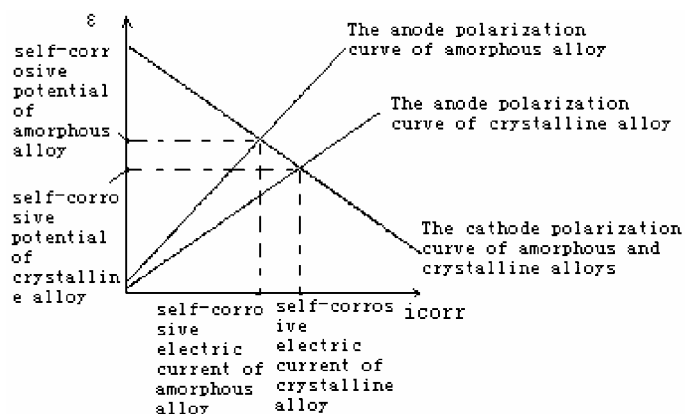


Fig.5. Self-corrosive potential schematic diagram of amorphous and crystalline alloys

#### 4. Conclusion

Compared with the polarization curves of amorphous and crystalline alloys, the self-corrosive potential of crystalline alloys generally moved towards negative direction. It can be believed that anode reaction of amorphous alloys was more unreactive and had higher self-corrosive potential and smaller self-corrosive electric current compared with crystalline alloys. Therefore, ZrTiCuNiBe bulk amorphous alloy exhibits good corrosion resistance.

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