

Pitting corrosion susceptibility of Fe-based metallic glasses in different media as a function of compression

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The present work was carried out to study the effect of compression on the electrochemical behaviour of the metallic glass ribbons of compositions, $\text{Fe}_{40}\text{Ni}_{38}\text{Mo}_4\text{B}_{18}$ and $\text{Fe}_{30}\text{Ni}_{39}\text{Mo}_4\text{B}_{12}\text{Si}_6$. Specimens of dimensions, $10 \text{ mm} \times 10 \text{ mm} \times 4.25 \mu\text{m}$ were compressed in the load range of 1 to 40 KN, using Instron universal testing machine. The compressed specimens were subjected to electrochemical studies in 3% NaCl solution, using a microprocessor controlled corrosion console, along with characterisation in S.E.M.

Key words: Pitting corrosion, metallic glasses, susceptibility.

INTRODUCTION

Metallic glasses are formed due to the rapid solidification process. They are glassy amorphous materials. These glassy materials have no atomic-ordering and hence their behaviour is not similar to the conventional crystalline materials [1,2,3]

EXPERIMENTAL

Metallic glass pieces were cut into square pieces, $10 \text{ mm} \times 10 \text{ mm} \times 42.5 \mu\text{m}$, using a shear-cutter. Compression was conducted in Instron-machine, in steps of 1 KN, 5 KN, 10 KN, 20 KN, 40 KN. The dimensional changes on compression, were observed to be occurring in very narrow-range as compression increased from 1 KN to 40 KN. Tafel parameters and pitting mode-data were obtained from

corrosion console, which is controlled by microprocessor.

RESULTS AND DISCUSSION

Table-I reveals the electrochemical parameters, as a function of compression-load, both in Tafel-mode and pitting-mode. It is clearly seen from the experiments in Tafel-mode that, I_{corr} values increase with increase in compression-load, while the E_{corr} values remain unchanged. For both FeNiMoB and FeNiMoBSi, the cathodic reactions appear to be more important as shown by the comparatively higher values of B_c . The data in pitting mode indicates that with increase in compression load, from zero to 40KN, the hysteresis load area, generated by the forward and backward, increases with decrease in polarisation resistance indicating that compression load appears to increase the corrosion, in

TABLE-I: Electrochemical parameters as a function of compression-load, by using corrosion-console in Tafel-mode and in pitting-mode

Compression load (KN)	$\text{Fe}_{40}\text{Ni}_{38}\text{Mo}_4\text{B}_{18}$					$\text{Fe}_{39}\text{Ni}_{39}\text{Mo}_4\text{B}_{12}\text{Si}_6$				
	Tafel mode		Pitting mode			Tafel mode		Pitting mode		
	E_{corr} (mV)	I_{corr} ($\mu\text{A cm}^{-2}$)	Area (mm^2)	R_p (Ohms)	Inflexion pot. (mV)	E_{corr} (mV)	I_{corr} ($\mu\text{A cm}^{-2}$)	Area (mm^2)	R_p (Ohms)	Inflexion pot. (mV)
0	-526	18	326	2.2	-200	-480	59	280	3.5	-168
5	-522	19	405	1.6	-160	-571	12	715	-	-196
20	-497	17	965	—	—	-461	40	710	3.2	-160
40	-535	22	1070	1.5	-160	-489	77	498	2.3	-176

pitting-mode. Subsequently the hysteresis-area, bounded by the forward and backward curve increases and the E_{corr} values tend marginally to more negative direction. The inflexion potential, formed by the forward and backward curve tends to a more positive potential for the FeNiMoB ribbon, while it is unaffected for FeNiMoBSi ribbon. S.E.M. studies reveal that compression results in redistribution (Figs. 1 and 3) and homogenization of microstructure and the FeNiMoBSi ribbon shows coarser microstructure than FeNiMoB ribbon (Figs. 1 and 2).



Fig. 1: FeNiMoB-met-glass ribbon without any compression



Fig. 2: FeNiMoBSi-met-glass ribbon without any compression

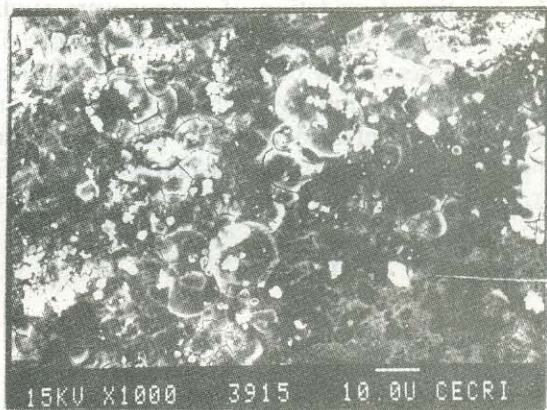


Fig. 3: FeNiMoB-met-glass ribbon-compressed 20 Kn

CONCLUSION

I_{corr} values increase, due to increase in compression-load, for both the ribbons studied. However cathodic reactions are more predominant, as indicated by higher B_c values. Increase in compression load in the range of 0 KN to 40 KN increases the area, generated by the hysteresis loop, in both forward and backward scan, coinciding with each other. Effect of compression load on pitting tendency appears to be FeNiMoBSi ribbon.

REFERENCES

1. D Mukherjee, C Rajagopal, S Guruviah, K S Rajagopalan, *Chem Age India*, **32** (1981) 915
2. D Mukherjee, G T Parthiban and M Mahalingam, Preprints, *10th I C M C*, 7-11, November 1987, p 1719
3. D Mukherjee, R Argode, S Guruviah and K S Rajagopalan, *Trans SAEST*, **19** (1984) 160

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