Low-cycle Fatigue Performances of P/M Ti-Fe-Mo-Al-Nd Alloy

Liu Haiyan[1,a], Tang Huiping[1,a], Li Cheng[1,a], Huang Yuanping[1,a], Huang Boyun[2,a], LiuYong[2,a]

[1] Northwest Institute for Nonferrous Metal Research, Shanxi, Xi'an, 710016
[2] State Key Laboratory for Powder Metallurgy, Hunan, Changsha, 410083
[a]email: fys@c-nin.com

Abstract

The low-cycle fatigue performance and fracture of the P/M Ti-Fe-Mo-Al-Nd Alloys after sintering and forging have been studied. The linear regression equation of low-cycle fatigue lifetime has been obtained; the fatigue performances are objected under two different conditions. The fatigue fracture surface is analyzed by SEM. The low-cycle fatigue behavior of the P/M titanium alloy has been discussed.

Keywords : low cycle fatigue; powder metallurgy; titanium alloy

1. Introduction

Ti-Fe-Mo-Al-Nd alloy developed in the research of motor valve sits is one of the new materials with high performance, low cost made by North west institute for non-ferrous metal research. This alloy has many merits including high strength (σb≥1100MPa), high ductility (δ5≥14%), high ware resistance, which is equivalent to TC4 alloy widely used for components. In this study, fatigue performance of sintered and wrought Ti-Fe-Mo-Al-Nd alloys was tested respectively, and the principle of fatigue behavior was discussed.

2. Experimental and Results

Low-cycle fatigue lifetime prediction equation of sintered and wrought P/M Ti-Fe-Mo-Al-Nd alloys were obtained respectively by liner regression of the experimental data, as shown in Tab 1.

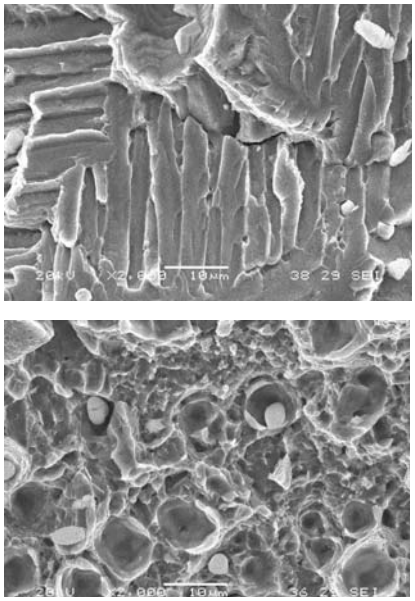

Fig. 1. Fatigue fracture of sintered and wrought Ti12LC+1.2wt%Nd alloys.

Table 1. Fatigue data of sintered and wrought Ti12LC+1.2wt%Nd

	Low-cycle fatigue parameter					Fatigue lifetime equation
	σ_f'(MPa)	b	ε_f'	c	n′	
S	2512.4	-0.1317	0.06647	-0.79732	0.14175	$\Delta\varepsilon_t/2 = 0.02284(2N_f)^{-0.1317} + 0.06647(2N_f)^{-0.79732}$
F	2537	-0.1981	0.00482	-0.699	0.2861	$\Delta\varepsilon_t/2 = 0.0246(2N_f)^{-0.1981} + 0.00482(2N_f)^{-0.699}$

Where S is powder sintered Ti alloy; F is powder wrought alloy.

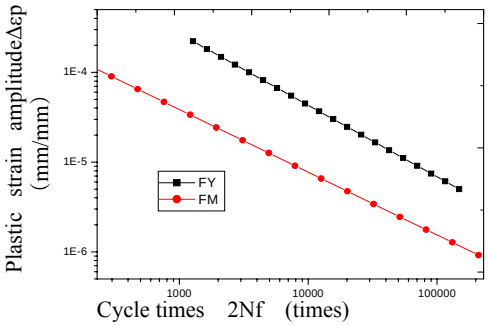

Fig. 2. The relationship between fatigue strain and cycle times.

The cycle times of powder wrought Ti alloy is higher than powder sintered Ti alloy under the same stress amplitude (shown as figure 1 and 2), it indicate that the fatigue performance of powder wrought Ti alloy is superior to powder Ti alloy. Both cycle strength factor and cycle strain hardening exponent of powder sintered Ti alloy is lower than powder wrought Ti alloy, which indicate that the fatigue stress-strain performance of powder sintered Ti alloy is lower than powder wrought Ti alloy.

3. Summary

1) Low-cycle fatigue lifetime equation was obtained by test of fatigue performance of powder sintered Ti alloy and powder wrought Ti alloy respectively, as shown in bellow:

$$\Delta\varepsilon_t / 2 = 0.02284(2N_f)^{-0.1317} + 0.06647(2N_f)^{-0.79732}$$

$$\Delta\varepsilon_t / 2 = 0.0246(2N_f)^{-0.1981} + 0.00482(2N_f)^{-0.699}$$

2) Extruding spine and ditch derived by glide was observed on the fatigue fracture surface.
3) The fatigue performance of powder wrought Ti alloy is superior to powder sintered Ti alloy mainly due to the decrease of inner porosity and amounts of crack derived by fatigue fracture.

4. References

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