Effect of surface treatments on fretting fatigue strength of aluminum alloy

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ABSTRACT

In this work, the effects of surface treatments such as wet blast, anodized coating and bonded solid lubricant on fretting fatigue strength of aluminum alloy (JIS A7N01) were investigated. As the result of fretting fatigue test, the fretting fatigue strength of the specimens treated by wet blast and anodized coating were almost equal to each other, and they were slightly higher than that of the untreated one. The fretting fatigue life of the specimen contacted with the contact pads coated with bonded solid lubricant was extremely improved compared to that of the specimen treated by the wet blast or the untreated one and matched the plain fatigue life.

INTRODUCTION

Recently, aluminum alloy has been used widely in machine structures to meet the demands for increases in productivity, reductions in production costs and reductions in weight. Therefore aluminum alloys have been increasingly utilized for automobile parts, aircraft parts and others. These materials require high strength for not only plane fatigue but also fretting fatigue. In order to increase the fretting fatigue strength, the surfaces of aluminum alloys have been treated.

In the present study, fretting fatigue tests using several surface treatments were carried out in order to investigate the effect of surface treatments on fretting fatigue strength of aluminum alloy.

EXPERIMENTAL DETAILS

The material used for specimen was forged aluminum alloy (JIS A 7 N01). Hot rolled steel plates for automobile structural uses (JIS SAPH440) were used for the contact pad. Three kinds of specimens were treated by wet blast, anodized coating, bonded solid lubricant coating and an untreated specimen was used as a control. Fretting fatigue tests were carried out in accordance with the standard of the Japan Society of Mechanical Engineers (JSME S 015).

Plain Fatigue Strength

The plain fatigue strength for the wet blast specimen was increased and that for the anodized coating specimen was decreased compared to the untreated specimen. We can infer that the reason for this increase in fatigue life was the delay of fatigue crack initiation and propagation due to the residual stress remaining on the surface of specimen by the wet blast treating.

On the other hand, the microscopic holds formed on the surface of the anodized coating induced the initiation of fatigue crack, hence the fatigue life of the anodized coating specimen was decreased.

Fretting Fatigue Strength

The S-N curves for fretting fatigue are shown in Fig.1. Fatigue lives of fretting fatigue tests specimens were extremely lower than those in plain fatigue tests. Fretting fatigue strength of the specimen treated with wet blast and the anodized coating specimen were almost equal to each other and they are slightly higher than that of the untreated specimen.

However, by using the contact pads coated with bonded solid lubricant, fretting fatigue life has been remarkably increased and attained the fatigue limits of its plain fatigue. The reason of this improvement is caused by considerable decrease of the tangential friction coefficient between specimen and contact pads through the bonded solid lubricant.

Fig.1 S-N curve (fretting fatigue).

RESULT AND DISCUSSION