Static and Fatigue Strength of Steel and Aluminum Alloy Plates Adhesive Bonding

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1. Introduction

Recently, such as nitrogen oxides and carbon dioxide emitted from automobiles is a serious issue, because these gases affect the environment, and it is considered that one of the solutions is reduction of weight of the vehicle in order to reduce these gases emissions. Using Multimaterial to the vehicle body is useful technique for reduction of weight. However there is no effective bonding method for Multimaterial. Although the adhesive bonding method is suitable for this, bonding strength of Multimaterial is not clear.

In order to establish a useful bonding method for Multimaterial, adhesive bonding method is developed in this research. Static and fatigue strength of adhesive joint was examined to determine the best bonding method for automobile.

2. Experimental Procedure

In this experiment, the static and fatigue strengths of the bonding material were examined by a fatigue test in which a cyclic load was applied. The adhesion layer thickness was constant, and two kinds of diameters are selected as an adhesive round area in order to examine the dependence of the adhesive area on fatigue strength. The experimental conditions are shown in Table 1. The materials used for the test pieces are general cold rolled steel plate (SPCC) and aluminum alloy plate (A5052). The test piece was made into an H-shape by stacking two U-shaped pieces.

Table 1　Experimental conditions

Adhesive area	Thickness [mm]	0.46
	Bonding Circle Diameter [mm]	φ20, φ26
Fatigue test	Loading mode	Tensile
	Stress ratio	0.1
	Frequency [Hz]	3

3. Test Results

The relationship between the load range and the number of cycles to failure, obtained from the tensile fatigue test of the adhesive bonding material is shown in Fig.1. It was found that fatigue strength of joint depends on the diameter of adhesive area. In addition, it was found that the failure mode of the adhesive changes with applied load, and the strength of joint also vary along with an amount of interfacial fracture mode.

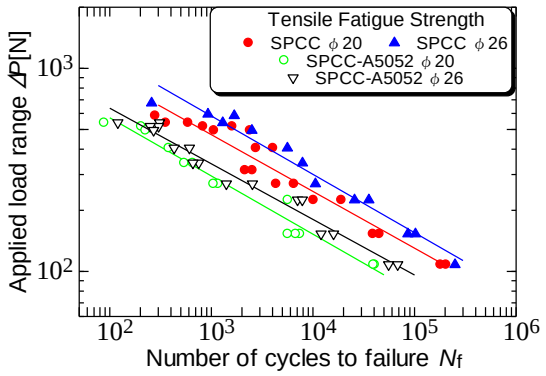

Fig.1 Fatigue test results

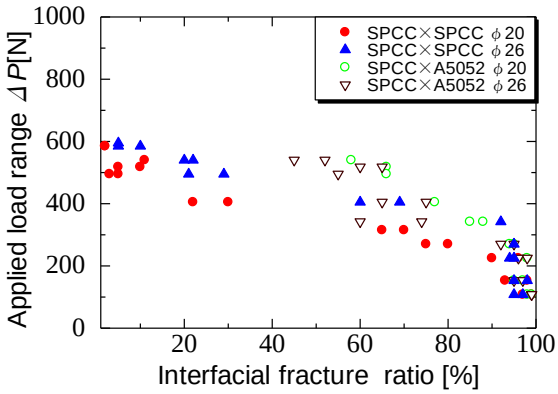

Fig.2 Transition of fracture mode

4. Conclusion

In the adhesive bonding method, it was found that the fatigue of strength linearly increased with the bonding circle diameter. Moreover, it became clear that the fatigue strength didn't depend on the area of the joint surface but on the circumference of adhesive circle, and it was found that the failure mode of the adhesive strongly influenced the strength.

References

[1] A.KITAKAZE and I.NISHIKAWA, study on static and fatigue strength of joint structure of high tensile strength steel[Proceedings of the 60th JSMS Annual Meetings] (2011) 117-119