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SUMMARY OF Ph.D. DISSERTATION

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Title

Fatigue Properties of Thermally Sprayed Steel with Ni-Based Self-Fluxing Alloy and Its Controlling Factor

Abstract

Thermal spraying is one of the most popular surface coating techniques which can create various properties on the surface of a substrate by bonding molten or semi-molten high performance alloys. This process has been used in several fields of industries for the improvement of corrosion and wear resistance of the materials and also used as a thermal barrier coating for gas turbine blades. To achieve the most efficient use of this technique in practice, it is very important to clarify the fatigue properties of thermally sprayed steel. However, very few studies have been carried out on the fatigue properties of thermally sprayed steel.

In this study, a high cycle fatigue properties of the steel thermally sprayed with a self-fluxing alloy were investigated with special attention to the relation between the coating microstructure and the fatigue strength.

Chapter 1 describes the motivation specific to this thesis while discussing the previous studies related to the characteristic of the thermally sprayed steel.

In chapter 2, the fatigue properties of the three types of thermally sprayed specimens with different heating periods in the fusing process were investigated to make clear the effects of fusing conditions on the microstructures and on fatigue properties. The results show that, (i) heating periods strongly affects the fatigue properties; the longer the heating periods, the lower the fatigue strength, (ii) the fatigue strength of the specimen fused in a short period by using an induction heating system is much lower than that of the specimen fused by a vacuum furnace. This is because a delamination between the coating layer and the substrate occurs during the fatigue process.

In chapter 3, to investigate the effects of the surface roughness of a substrate on fatigue properties of a thermally sprayed specimen, three types of sprayed specimens with a different surface roughness of the substrate were prepared. The results show that, (i) in the case of the interface delamination mode, the surface roughness of the substrate affects the fatigue properties; the rougher the substrate, the higher the fatigue strength, (ii) in the case of the surface fracture mode, the roughness of the substrate surface has no effect on the fatigue strength of the sprayed specimen.

In chapter 4, the effects of the coating thickness on fatigue properties of thermally sprayed specimens were investigated. As a result, it became clear that coating thickness strongly affects the fatigue properties of the sprayed specimens; the thinner the coating thickness, the higher the fatigue strength. This is because the thinner coating contains smaller and less coating defects.

Chapter 5 summarizes the results of this study.