SUMMARY OF Ph.D. DISSERTATION

School Integrated Design Engineering	Student Identification Number	SURNAME, First name KIKUCHI, Shoichi

Title

Improvement of Fatigue Property and Its Mechanism on Steel Modified by Hybrid Surface Treatment Using Fine Particle Peening

Abstract

Fine Particle Peening (FPP) treatment is a common commercial process to improve the fatigue properties of steel by creating high compressive residual stress at the surface of metal components. However, treating surfaces with only one process has some limitations in improving the fatigue strength. Therefore, it is necessary to develop a new hybrid surface modification process. In this study, in order to achieve higher fatigue strength, a hybrid surface modification process using FPP treatment was proposed. The mechanism of microstructural change induced by the FPP treatment and the proposed hybrid surface modification, and its effect on fatigue properties of steel, are discussed.

Chapter 1 summarizes the background, previous studies, and the aims of this study.

Chapter 2 describes the typical feature of microstructural change by the FPP treatment. Fine grain microstructure was able to be generated by FPP treatment under lower energy conditions in comparison to ordinary shot peening.

Chapter 3 clarifies the dominant factor which affects the mechanism of generating the modified layer by hybrid surface modification (a combination of heat treatment and FPP treatment).

Chapter 4 clarifies the effect of the hybrid surface modification process on fatigue properties of steel. The fatigue strength of modified steel was improved significantly. This was due to the generation of a dense compound layer at the surface of the nitrided specimen pre-treated with FPP.

In Chapter 5, the proposed hybrid surface treatment was introduced to austenitic stainless steel with passive film on its surface, and showed that the treatment was very effective in improving the fatigue properties. The fatigue fracture mechanism of the hybrid surface modified specimen was also discussed.

Chapter 6 proposes a new surface treatment system combining high-frequency induction heating (IH) and FPP. This IH-FPP treatment generated a surface with high hardness and an extremely fine grained microstructure, resulting in improving fatigue strength of steel.

Chapter 7 summarizes the results of this study.