EFFECTS OF THE HEAT TREATMENT ON FATIGUE WEAR OF GEAR STEEL UNDER ROLLING/SLIDING CONTACTS

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Friction; Rolling contact fatigue; Solid lubrication, Heat treatment

ABSTRACT
The miniaturization of EV power units called e-axle is being promoted. However, the number of contacts between gear tooth flanks increases with its miniaturization and higher motor speeds. Therefore, fatigue wear, such as pitting, will increase. Heat treatment improves fatigue wear resistance. Especially, carburizing quenching is the mainstream heat treatment for gear surfaces. However, this heat treatment requires large deformation after treatment. For this reason, soft nitriding, which requires less deformation, has been attracting attention.

In this study, rolling fatigue friction tests were performed under different conditions of SRR, load, and specimen heat treatment to evaluate pitting resistance and to investigate its mechanism. We observed the cross section to investigate crack propagation (Fig.1). DAP of carburizing and soft nitriding increased and decreased as SRR increased, respectively (Fig. 2). The mechanism that improves pitting resistance is considered to the effects of compound layer produced by the soft nitriding (Fig. 3). Soft nitriding has two different phases composed of ε phase as first layer and γ' phase as second layer. The ε phase has low hardness (Nanoindentation hardness: 3.4 GPa) compared to carburizing surface (Nanoindentation hardness: 8.9 GPa) and decreased contact pressure and formed running-in surface, additionally, γ' phase protects the crack propagation due to the high hardness layer. In our presentation, we will report the detailed mechanism of pitting resistance on soft nitriding when SRR increase.

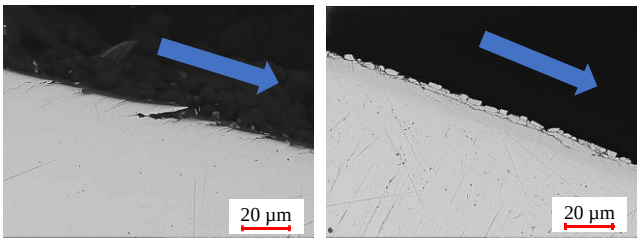

Fig.1 Images of cross section (carburizing, soft nitriding)

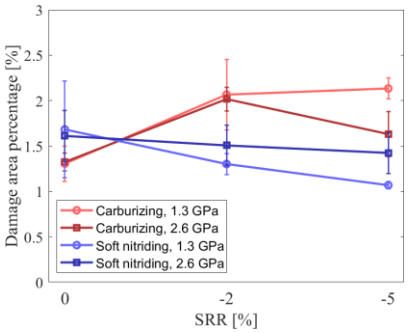

Fig.2 Damage area percentage

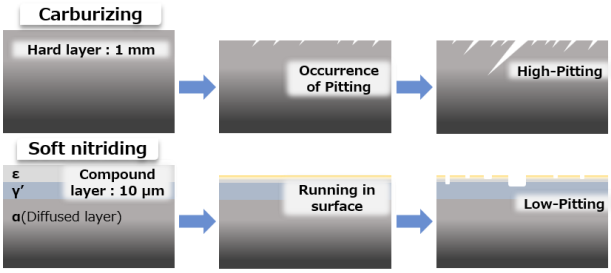

Fig.3 Mechanism of fatigue wear by carburizing and soft nitriding at rolling and sliding conditions

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