§8. Dynamic Strain Aging Phenomenon Observed in Low Cycle Fatigue Behavior of JLF-1 at 673K

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Reduced activation ferritic/martensitic (RAF/M) steels are considered for structural application in potential fusion energy systems. The transient of thermal and mechanical loading of ITER and DEMO-blankets poses the problem of fatigue at different temperature.

Dynamic strain ageing (DSA) is a phenomenon commonly observed with low carbon alloy steels at a temperature rang from 423K-673K, where carbon atoms in the steel matrix can interact with dislocations to form Cottrell atmospheres. But there are scarce information available on the effect of DSA on the mechanical properties and accompany substructure of the RAF/M.

In this work, the water cold jacket for the displacement was designed to keep the temperature of the extensometer in stable during fatigue experiment; and the DSA phenomenon was observed in the Low cycle fatigue (LCF) experiment in vacuum at 673K.

RAF/M steel, JLF-1 was machined to cylindrical specimens with 18 mm in parallel and 8 mm in diameter and polished along the longitudinal direction with #1500 paper to erase the circumferential machining marks. LCF tests were carried out in 5×10^{-3}Pa at 673K under fully reversed axial strain control using a Shimazu Servo Pulser with a dynamic load capacity of ±10 ton. The axial strain was measured by an extensometer (Shinko 1501-93-20, G.L. is: 12.5mm).

Fig.1 shows the water cold jacket and its support frame, which could keep the temperature of extensometer below working limits during fatigue test at 673K. As the operating space in the vacuum chamber was very limited, the water cold jacket could move up and down along vertical direction when the extensometer was adjusted.

Fig.2 shows the serration phenomenon observed during fatigue at strain rang in ±1.0%, frequency:0.05Hz; and Fig. 3 shows the same phenomenon at strain rang in ±1.0%, frequency:0.01Hz.

This phenomenon was considered as the DSA effect which have been explained in terms of the interaction between moving dislocations and diffusing solute atoms. So, the temperature range and the strain rate sensitivity (SRS) should be studied in detail in the next work.

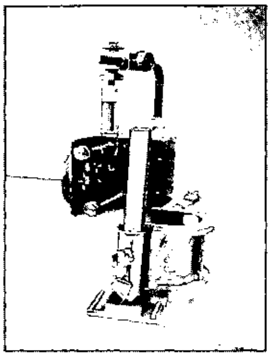

Fig. 1 Water cold jacket for the extensometer

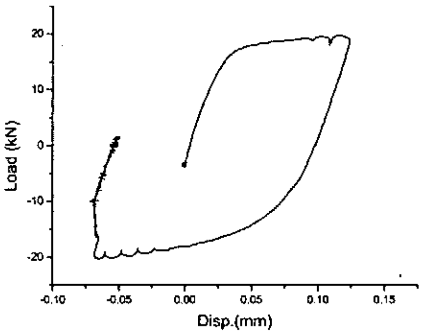

Fig. 2 Serrations of hysteresis curves at ±1.0%, 0.05Hz.

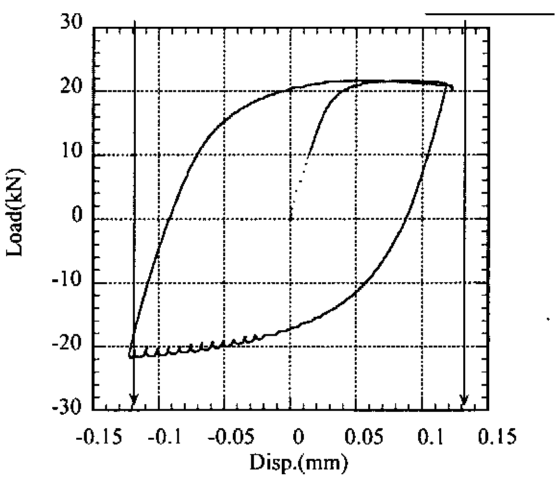

Fig.3 Serrations of hysteresis curves at ±1.0%, 0.01Hz.