Behavior of Dynamic Strain Aging for Superalloys

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1. Introduction

Superalloys have been used at IHX and hot gad duct of VHTR because the operating temperature is 950℃ for VHTR. Many candidate superalloys for application to VHTR have been studied in other country (France, Germany, USA, Japan). Mechanical and microstructure of superalloys are degraded because alloys are aged at high temperature during operation. Dynamic strain aging (DSA) is a factor that decreases the high temperature mechanical properties because DSA increases strength but decreases ductility. In this study, DSA behaviors of superalloys are investigated and compared.

2. Experimental procedure

Superalloys for test are commercial Hastelloy-X, Alloy 617, Haynes 230. Chemical compositions of alloys are satisfactory to ASME reange. Tensile tests were conducted at RT-1000℃ and strain rate was $2x10^{-3}$/s. Tensile test specimen was 2mm thick, 6.25 mm width, 25 mm gauge length. All tests were conducted at air environment.

3. Results

Tensile strength and elongation are show in Fig. 1. Yield stress and UTS are not greatly different with alloys but elongation of Haynes 230 is the worst especially at high temperature.

Serration was shown in 300-800℃ temperature range in Fig. 2. Serration is a evidence for DSA. Elongation was decreased in the temperature range which DSA was occurred but increased at above 900℃ which DSA did not occur. Temperature range of Hastelloy-X for DSA is lower than those of Alloy 617 and Haynes 230. The magnitude of serration from top to bottom was shown in Table 1.

DSA of Hastelloy-X was severe at high temperature but Alloy 617 was not severe, Haynes 230 was sever at low and high temperature because tensile strength was increased but elongation was decreased for Haynes 230.

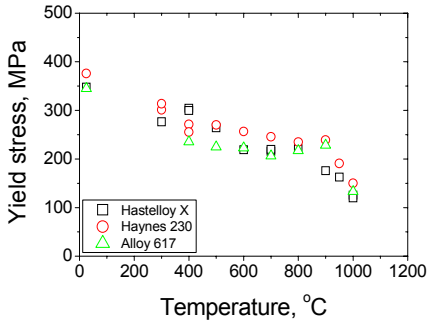
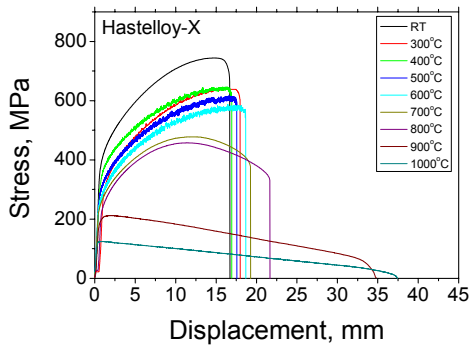
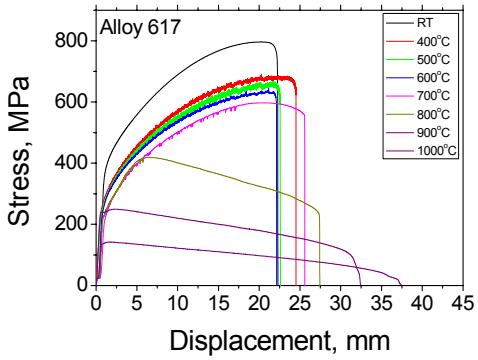


Fig. 1. Tensile properties of superalloys





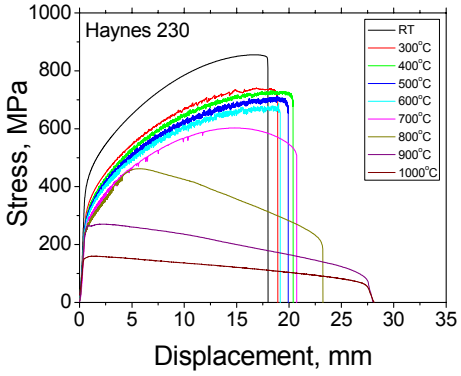


Fig. 2. Tensile curves for superalloys

Table 1. Stress change for serration

	Δσ, MPa	
	500℃	**600 ℃**
Hastelloy-X	**8**	**18**
Haynes 230	**19**	**19**
Alloy 617	**20**	**8**

4. Conclusion

Yield stress was not different with alloys (Hastelloy-X, Alloy 617, Haynes 230). Elongation of Haynes 230 was decreased at above 900℃. The temperature range for serration was 300-800℃. Alloy 617 was the most resistant to DSA.

Acknowledgement

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