The effect of coolant temperature on stress corrosion cracking behavior of SUS316L in fusion relevant environments

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Abstract

SCC behavior of solution-annealed 316L SS in hot water ranging from ambient to 561K was investigated by SSRT. Dissolved-hydrogen (DH) ranged from 0 to 1.4 ppm. Results showed a temperature-concentration dual dependence. IG initiating-TG propagating cracking pattern was observed. SCC behavior can be interpreted in terms of hydrogen-assisted SCC.

Keywords: stress corrosion cracking, hydrogen embrittlement, hydrogen decohesion

1. Introduction

Authors presume that corrosion behavior of steels in hydrogenated hot water strongly depends on temperature as hydrogen behavior in steel does. Dissolved-hydrogen content in water might affect, too. Furthermore, the DH effects on the SCC nucleation process and growth process are possibly different, and the CGR method is less suitable for the investigation of crack nucleation behavior. In this study, the effects of test temperature and DH content on the SCC susceptibility of solution-annealed 316L SS are investigated by SSRT method and the SCC behavior and mechanism are discussed with focusing on the temperature/DH content dependence of SCC nucleation process.

2. Experimental

Commercial 316L SS were machined into plate-type (SS-J type) specimens. Solution-annealing was carried out at 1323K, 1h, water quench (W.Q.) SSRTs were conducted in hot water. After SSRT, fractured surface are examined by SEM.

3.Results and conclusion

As testing temperature increases, total elongation decreased and brittle fracture area increased. IG initiating-TG propagating cracking was found on specimens tested at 561K with DH ranged from 0 to 1.4ppm. Pure TG cracking was found on those tested at 493K, DH=1.4ppm. Oxide thickness increased as temperature increased. Results showed a temperature-concentration dual dependence. SCC behavior can be interpreted in terms of hydrogen-assisted SCC.