EFFECT OF HYDROGEN ON CREEP PROPERTIES OF SUS304 AUSTENITIC STAINLESS STEEL

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The objective of this study is to gain a better understanding of the degradation of metals in high-temperature hydrogen in order to provide a basic science that enables ensuring the safety of developing high-temperature hydrogen technologies. A creep test was carried out in argon and hydrogen gases under a gas pressure of 0.12 MPa in absolute pressure at 873 K. The material was JIS SUS304 austenitic stainless steel.
The creep rate in hydrogen was significantly increased compared to that in argon. As a result, the creep life in hydrogen was drastically reduced. The saturated hydrogen concentration in the material at 873 K was estimated as 5.3 mass ppm. Regarding the creep fracture surface, creation of dimples was promoted in the hydrogen gas, whereas intergranular cracking was dominant in argon. In contrast to the reduction in creep life (time-to-failure), the creep ductility (strain-to-failure) was increased in hydrogen. Based on the observation of the fracture surface and measurement of the creep ductility, hydrogen enhanced plasticity at 873K.

In order to consider the mechanisms that hydrogen reduced the creep life, the effects of decarburization and carbide formation were investigated. The carbon content didn't change before and after the creep test in hydrogen. In addition, the creep life of the lower carbon SUS304L was reduced in hydrogen similar to the SUS304. These results suggested that the effects of decarburization and carbide formation were minor contributors to the reduced creep life at least within the creep life range of this study.