

Governing Factors to Delayed Hydride Cracking in Zr-2.5Nb Tubes

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Abstract

DHC tests have been carried out at different temperatures ranging from 100 to 280°C on the compact tension specimens of Zr-2.5Nb pressure tubes with different yield strengths and the hydrogen concentration of 12 to 100 ppm. With the increasing supersaturated hydrogen concentration, DHC velocity (DHCV) of the Zr-2.5Nb pressure tubes has increased exponentially to a constant and its threshold stress intensity factor, K_{IH} also has decreased. Thus, DHCV and K_{IH} can be nicely described as a function of the supersaturated hydrogen concentration over the terminal solid solubility for dissolution (TSSD) independent of temperatures. Another factor to control DHCV is yield strength of the Zr-2.5Nb pressure tube: faster DHCV for the Zr-2.5Nb tubes with higher strength. By normalizing DHCV of the Zr-2.5Nb tubes by the solubility and diffusivity of hydrogen, DHCV is found to have a linear relation only with yield strength, irrespective of temperatures. Therefore, delayed hydride cracking of Zr-2.5Nb pressure tubes is governed by their tensile strength and a difference in the hydrogen concentration in solution between the crack tip and the bulk regions. A driving force for DHC is discussed from a view point of the concentration gradient and diffusivity of hydrogen.