Hydrogen Permeation Behavior of BN Film

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The hydrogen permeation behavior of BN-coated Type 316L stainless steel was investigated. In comparison with TiN and SiC films, the BN (boron nitride) film, deposited by molecular beam epitaxy (MBE), was effective to reduce the rate of hydrogen permeation through stainless steel (Fig. 1).

Hydrogen-permeation tests were performed on the coated stainless steel samples. These tests were based on the differential-pressure methods in ISO15105-1.
The permeation of hydrogen through solid materials involves a series of steps including adsorption, dissociation, diffusion, and recombination coupled with desorption.

The permeability, Q, is generally defined by the expression

$$Q = J\, d / A\, (dP)^{n}$$

where J is the permeation flux of hydrogen through a sample of area A and thickness d, under a partial pressure gradient (dP) across the sample called the driving pressure. The exponent n represents different permeation regimes: diffusion-limited and surface-limited when n = 0.5 and 1, respectively.
The double-logarithmic plots showed that the two sets of data of BN- and TiN-coated samples were linearly related. The exponent n showed a value of 0.48–0.53 at 573–773 K, which indicated that hydrogen passed through the samples in the diffusion-limited permeation mode.

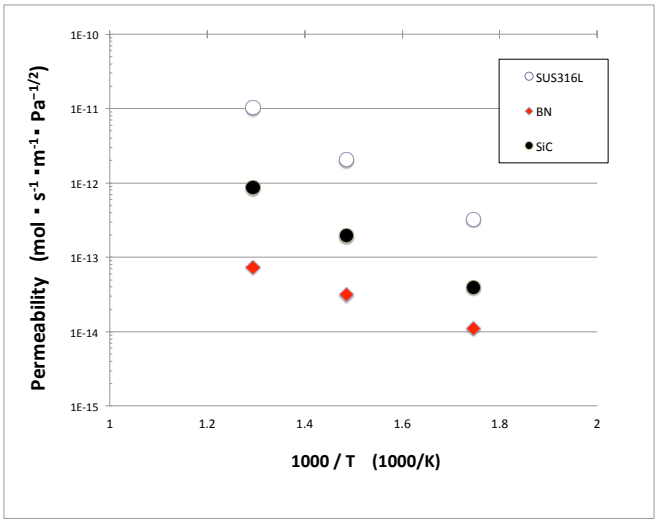

Figure 1. Arrhenius plot of hydrogen permeability as a function of temperature.

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