§53. Numerical Analysis for Pressure Rise of Vacuum Chamber due to LOCA and Gas Desorption Properties of Plasma Facing Material Polluted with Coolant Water

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Active cooling components have to be employed in the divertor of a fusion reactor to handle the large power flow from the core plasma. The extremely large thermal stress and electromagnetic force acting on these component may cause cracking of the cooling pipe. In this study, the pressure rise of vacuum chamber due to leak of water vapor was calculated. In addition, the gas desorption properties of plasma facing material (PFM) dipped in the water was examined.

In the numerical analysis of the pressure rise, it was assumed that the temperature and pressure of water were 100 °C and 3.5 MPa, respectively. Figure 1 shows the change of vacuum chamber pressure when the expansion volume with a size same as the vacuum chamber is opened after the occurrence of LOCA. In the case with a large conductance between vacuum chamber and expansion volume, the pressure initially decreases, but after a short time period linearly increases. The time period until the pressure increases up to 2 atm, e.g. designed pressure of vacuum chamber, becomes 3 hr and 300 hr when the pinhole diameter is 10 mm and 1 mm, respectively.

Figure 2 shows thermal desorption spectra of hydrogen and water desorbed from the CFC before and after the dipping in the water. After the CFC dipped in the water, desorption amounts of hydrogen and water become one order of magnitude larger compared with the case before the dipping. In addition, the desorption rate of hydrogen and water largely increased at lower temperature region, e.g., less than 700K. This data may be useful for outgassing of the contaminated wall after LOCA.

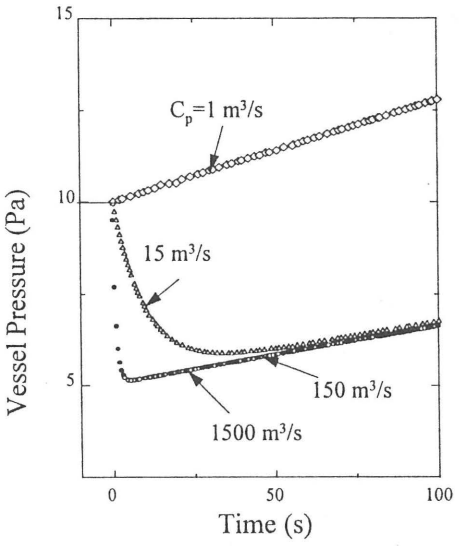

Fig.1. Change of chamber pressure when the expansion is opened. Break diameter of pinhole is 0.1 mm. C_p is the conductance between chamber and expansion volume.

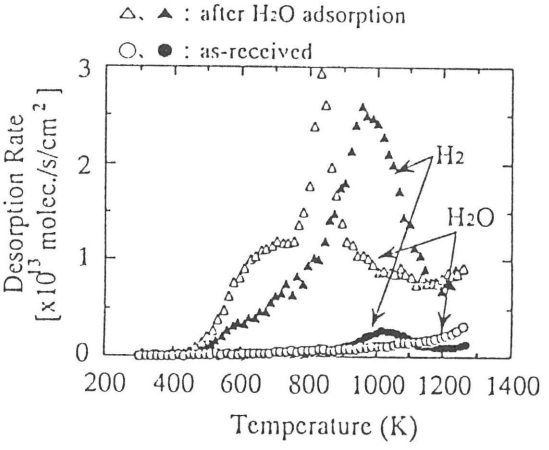

Fig.2. Thermal desorption spectra of hydrogen and water of CFC dipped into water.

References

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