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Forced Flow Boiling Heat Transfer Properties of Liquid Hydrogen for Manganin Plate Pasted on One Side of a Rectangular Duct

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Liquid hydrogen has excellent properties such as large latent heat, low viscosity and so on. Therefore liquid hydrogen is expected to be used as a coolant for the high critical temperature superconducting devices. The larger heat is inputted to the superconducting device, the higher the temperature of it gets in film boiling phenomenon, which make it quench. In order to design superconducting devices in liquid hydrogen, it is necessary to clarify the cooling properties of liquid hydrogen and the effect of forced flow liquid hydrogen. Forced flow boiling heat transfer of liquid hydrogen from inner surface of heated tubes with several diameters and lengths have been studied under wide range of experimental conditions [1]. However there would be many shapes of liquid hydrogen flow passages and heated surfaces in actual cooling of superconducting devices.

In this work, boiling heat transfer and DNB heat flux were measured for a vertical Manganin plate pasted on one side of a rectangular duct made of FRP (Fiber Reinforced Plastic) with 4.2 mm x 10 mm in cross section and 160 mm in length. The test heater plate is 10 mm wide, 120 mm long and 0.1 mm thick. Liquid hydrogen flows upward in the duct. Temperature of the test plate was measured by resistance thermometry. Nucleate boiling heat transfer and its DNB heat flux were measured for the various pressures, flow velocities, and subcoolings. The DNB heat fluxes are higher for higher flow velocities and higher subcoolings. The DNB heat fluxes were compared with the experimental data for round tube of nearly equal equivalent diameter. The DNB heat fluxes for the rectangular duct are lower than those for the round tube. [1]Shirai.Y., Tatsumoto.H., Shiotsu.M., Hata.K., 2011, "Cryogenics vol.51", pp295-299

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