

Hydrogen and Neon Gas-Gap Heat Switch

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ABSTRACT

Heat switches are important devices in many cryogenic setups, especially in space applications and many systems have been used to allow a good ability to make or break a thermal contact. Among them, the so-called gas gap heat switches, in which the pressure is managed thanks to a small cryopump, are known to be very reliable and simple, principally due to the nonexistence of moving parts. However, in such switches, the gas characteristics and its adsorption properties have to be taken into account to determine their functioning temperature ranges. In this article, a gas gap heat switch, with a charcoal adsorption pump, tested with neon and hydrogen as conducting gas is described. The experimental results are presented and compared with calculation from a simple thermal model. Avoiding the gas condensation, limiting the OFF conductance and reaching a viscous regime in the ON state lead to an operational temperature window for the sorption pump that depends of the amount of gas.

For neon, the minimum temperature to actuate our switch ranges from 17 K to 40 K; for hydrogen, this temperature range goes from 9.5 K up to 55 K. Such switches offer an extension to the well-studied helium gas gap heat switch which is limited to temperatures up to 15 K.

Measured values for the thermal ON conductance (74 mW/K at 20 K for neon, 110 mW/K at 11 K for H₂) compare very well with the results expected from gas conductivity properties found in literature. For neon an ON/OFF conductance ratio about 220 is obtained at 20 K, whereas, for H₂, a ratio up around 440 was measured at 11 K.

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