

# **The temperature online monitoring of Hall thruster electromagnetic coils**

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A Hall thruster is a typical energy conversion device in certain near-Earth missions, such as satellite station keeping and orbit transfer. In symmetric cylindrical structure the discharge is established through an externally applied crossed electromagnetic field. The neutral propellant is ionized and accelerated to produce thrust. Electric energy is converted into the kinetic of plasma and thermal energy. Magnetic field formed by the energized coils plays a vital role on the performance of Hall thruster. The coils power consumption is typically changed from 10 watts to 100 watts. Most of the power consumption is dissipated in the form of heat exhaustion. At the same time the Hall thruster plasma discharge process produces a lot of heat which is transmitted to the coils through the ceramic wall, making the coils temperature higher. In vacuum environment the compact and narrow excitation winding space limit the coils heat dispersal. Also high temperature would accelerate the conductor aging process and lead to more failure. Therefore coil temperature is an important indicator to reflect the state and reliability of Hall thruster.

The Hall thruster coils are usually made from metal wires, such as copper and nickel. As we know, the resistance of most metal increases with the temperature. Base on the thermal characteristics of metal wire, we propose a coil temperature online monitoring method with no additional measuring devices. Using the thermal steady state voltage and the current of coils, the temperature of coils can be estimated. Experimental results indicate that this method has the accuracy of 10°C in the low temperature range and 3°C in the high temperature range. This method does not increase any measuring element, keep the Hall thruster structural parameters and the original structural optimization, achieve the temperature online monitoring of Hall thruster electromagnetic coils. It is suitable for flight-type Hall thrusters and also for the temperature online monitoring of the various coil class aerospace equipment with the advantages of simple structure, easy to implement, and moderate accuracy.