RFID-Based Wireless Thermal Convection Angular Accelerometer by Using Semi-Spherical Chamber and Xenon Gas

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Abstract

In this paper five new ideas are proposed to integrate both an active RFID tag with a thermal convection angular accelerometers on a flexible substrate, thus the device is a wireless angular acceleration sensor. The first innovative idea is that this device is similar to the thermal convection accelerometer; the new device is also without any movable parts, so the reliability is very good. The second new idea is to apply the plastic or polyimide as the substrate, the thermal conductivity of the flexible substrate is much lower than silicon, then it can save more power and very useful in various fields. The third new idea is to apply the inert xenon (Xe) gas in the chamber for heat convection instead of the carbon dioxide (CO2) that was used in the traditional thermal convection accelerometer. Because CO2 can produce oxidation effect to the heater and thermal sensors, while the proposed Xe gas will not. The fourth new idea is to apply a semi-spherical chamber that can ease the fluid flow, and yield larger sensitivity and quicker response. Since the semi-spherical chamber is more streamline in nature, thus drag effect is less. The fifth new idea and the most powerful one is to integrate an active RFID tag with a thermal convection angular accelerometers on the same substrate, thus the device becomes a more useful wireless angular acceleration sensor. Comparison of the chamber with Xe and traditional CO2 gases are included, the sensitivity and the response time of the new device are respectively as 100℃/(rad/s2) and 0.58 ms, while they are around 70℃/(rad/s2) and 0.76ms by using CO2. In summary, the new device sensitivity and response time are improved by 1.43 and 1.31 times, respectively

Keyword：Angular Accelerometer, RFID Tag, Flexible Substrate, Semi-Spherical Chamber, Thermal Convection