

Announcing the Final Examination of Xinhua Ren for the degree of Doctor of Philosophy

Time & Location: August 20, 2012 at 8:00 AM in HEC 450

Title: High Temperature Materials Characterization and Sensor Application

This dissertation presents new solutions for turbine engines in need of wireless temperature sensors at temperatures up to 1300oC. Two important goals have been achieved in this dissertation. First, a novel method for precisely characterizing the dielectric properties of high temperature ceramic materials at high temperatures is presented for microwave frequencies. This technique is based on a high-quality (Q)-factor dielectrically-loaded cavity resonator, which allows for accurate characterization of both dielectric constant and loss tangent of the material. The dielectric properties of Silicon Carbonitride (SiCN) and Silicoboron Carbonitride (SiBCN) ceramics, developed at UCF Advanced Materials Processing and Analysis Center (AMPC) are characterized from 25 to 1300oC. It is observed that the dielectric constant and loss tangent of SiCN and SiBCN materials increase monotonously with temperature. This temperature dependency provides the valuable basis for development of wireless passive temperature sensors for high-temperature applications. Second, wireless temperature sensors are designed based on the aforementioned high-temperature ceramic materials. The dielectric constant of high-temperature ceramics increases monotonically with temperature and as a result changes the resonant frequency of the resonator. Therefore, the temperature can be extracted by measuring the change of the resonant frequency of the resonator. In order for the resonator to operate wirelessly, antennas need to be included in the design. Three different types of sensors, corresponding to different antenna configurations, are designed and the prototypes are fabricated and tested. All of the sensors successfully perform at temperatures over 1000oC. These wireless passive sensor designs will significantly benefit turbine engines in need of sensors operating at harsh environments.

Major: Electrical Engineering

Educational Career:

Bachelor's of Electrical Engineering, 2006, University of Science and Technology of China

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Approved for distribution by Xun Gong, Committee Chair, on August 1, 2012.

The public is welcome to attend.