<table>
<thead>
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<th>Author/Company/University</th>
<th>J.-M. Boccard¹, J. Hoppe¹, T. Aftab¹, A. Yousaf¹, R. Hütter², L. M. Reindl¹</th>
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<tr>
<td></td>
<td>¹IMTEK, University of Freiburg, Germany, ²RSSI GmbH, Geretsried, Germany</td>
</tr>
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<td>Title:</td>
<td><strong>ZST Dielectric Resonator for Far-Field Passive High Temperature Sensing</strong></td>
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</tbody>
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### Abstract:

#### 1. Background, Motivation and Objective:

The lifetime of numerous aerospace and industrial applications can be effectively predicted by acquiring temperature information above 500 °C. Acoustic wave [1] and dielectric sensors [2] have been used for measuring high temperatures up to 1000 °C. In order to get a sufficient coupling between the reader antenna and the sensor, dielectric resonators are physically connected to metallic surfaces [2-3]. The resonance frequency shift is due to the material permittivity change and the thermal expansion when the temperature changes. However, the dielectric and ohmic losses decrease the quality factor Q and increase the sensitivity to the environment. The objective of this work is to measure high temperatures in the far-field region using a robust and self-radiating sensor with a Q factor higher than 500.

#### 2. Statement of the Contribution/Methods:

The novel temperature measurement concept is to use a zirconium tin titanate (Zr$_{0.8}$Sn$_{0.2}$TiO$_4$, ZST) dielectric resonator sensor working at 2.37 GHz and with no metallization on its surface. As a consequence, only the dielectric losses will affect the sensor Q factor at high temperature. A patch antenna connected to a RADAR-based interrogation unit using a time domain tracking mode allows the signal backscattering measurement through a chamotte stones oven up to a few meters.
3. Results/Discussion:

For the following experimental results, the distance between the sensor and the reader antenna was set to 1.2 m. As presented in figure 1, the tracked resonance frequency shift result shows an hyperbolic temperature sensitivity from room temperature to 700°C. The maximum frequency shift is about -4500 ppm and the Q factor decreases from 2860 to 675. The signal-to-noise ratio decreases from 45 dB to 19 dB. Further, the measured temperature deviation is equal to 0.13 K when the oven temperature is stabilized at 500°C. Finally, the sensor is not damaged after several cycles (no apparent change of color, resonance frequency and Q factor). Future work will focus on the determination of the temperature limit for this material, on the sensor size reduction and on the shift of the turn-over temperature.

![Figure 1](image)

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