Author:	D.W.Greve, Department of Electrical and Computer Engineering, Carnegie Mellon University, United States
Title:	**Surface acoustic wave devices for harsh environment wireless sensing**
Abstract:	**1. Background and Motivation** In oxy-fuel combustion of coal, separated oxygen is used so that the exhaust will be nearly pure carbon dioxide and water vapor. Sequestration of the carbon dioxide can be accomplished after condensation of the water vapor. We report progress toward the development of wireless oxygen sensors to be placed in the exhaust for improved operation efficiency. The exhaust is a harsh environment with temperature of the order of 900 °C. **2. Statement of Contribution/Methods** Surface acoustic wave sensors utilizing the electro-acoustic effect can be used for gas sensing. The acoustic path is covered with a layer that changes conductivity in response to changes in a gas concentration. In this work we use tin or zinc oxide as the gas-sensing layer and langasite as the piezoelectric substrate. These sensing layers have temperature-dependent sensitivity so a practical sensor must also measure temperature. The SAW devices consist of an emitting interdigitated transducer and multiple reflectors, operated in pulsed mode with a center frequency near 335 MHz.

3. Results/Discussion

We will report progress on wireless temperature sensing, the development of a compact high-temperature compatible antenna, and wired oxygen sensing. Wireless temperature sensing has been achieved up to 700 °C using a meander dipole antenna. Oxygen sensing has been studied in wired mode using both tin and zinc oxide sensing layers. Simultaneous temperature and gas sensing has been accomplished. However the oxygen response exhibits drift and slow response to oxygen concentration changes. Comparison of these sensing results with measurements of the sensing layer resistivity show different results when a diffusion barrier is used between the sensing layer and a langasite substrate. We attribute the drift and slow response of SAW sensors to oxygen diffusion into the langasite substrate. Oxygen diffusion can probably be prevented by an appropriate diffusion barrier.