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"Aluminum Nitride Enabled MEMS for Near-Zero Power Wakeup and High Temperature Capable Sensing"

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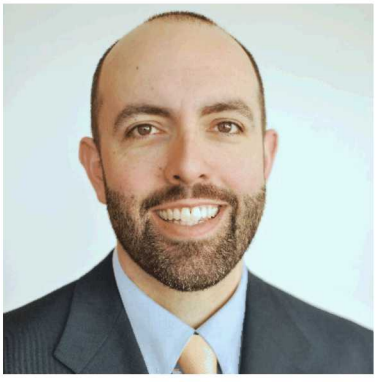
Abstract: With the proliferation of the commercial handset, the market for piezoelectric, aluminum nitride (AlN)-based MEMS is well established through bulk acoustic wave (BAW) devices such as film bulk acoustic resonators (FBARs) and solidly mounted resonators (SMRs). The maturation of this material has led to new opportunities in the application space. In this talk, I will address two such applications of AlN MEMS demonstrated by Sandia National Laboratories MEMS Technologies Department: high temperature capable MEMS and near zero power wakeup sensors.

Sandia demonstrated a MEMS material set that combined piezoelectric AlN with silicon carbide (SiC) for sensors that can withstand extreme temperatures. Piezoelectric transduction of AlN has been shown at temperatures exceeding 1000°C. SiC is a well-known high temperature capable semiconductor material. SiC and AlN are a promising material combination due to their high thermal, electrical, and mechanical strength and closely matched coefficients of thermal expansion. In this presentation, I will review Sandia's XMEMS process for AlN/SiC composite MEMS on SiC wafers for high temperature environments.

A second application space for AlN-based MEMS is in near zero power sensors. Sandia has demonstrated a passive, AlN-based MEMS accelerometer coupled to a sub-threshold, CMOS ASIC to create a near-zero power wakeup system. Resonant sensitivities as large as 490 V/g (in air) are obtained at frequencies as low as 43 Hz. Two accelerometers are coupled with the circuit to form the wakeup system which consumes only 5.25 nW before wakeup and 6.75 nW after wakeup. The system is shown to wake up to a generator signal and reject confusers in the form of other vehicles and background noise.

Background: Dr. Benjamin Griffin received the B.S. and M.S. degrees in aerospace engineering and the Ph.D. degree in mechanical engineering from the University of Florida (UF), Gainesville, in 2003, 2006, and 2009, respectively. He was a National Science Foundation Graduate Research Fellow at UF. From 2009 to 2011, he was an Engineer with the Interdisciplinary Consulting Corporation, developing next generation sensing technology for the aerospace community. From 2011 to 2018, he was a technical staff member with the MicroElectroMechanical Systems (MEMS) Technologies department at Sandia National Laboratories, Albuquerque, NM, where he led research programs in the area of MEMS sensors, actuators and resonators with a focus on piezoelectric devices. Dr. Griffin is currently a program manager with the Defense Advanced Research Projects Agency's Microsystems Technology Office.



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