

HARSH ENVIRONMENT MEMS FOR ENERGY & POWER APPLICATIONS

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Abstract: In this seminar, current research and future visions will be presented for extreme harsh environment, MEMS wireless sensors fabricated from silicon carbide and aluminum nitride. These sensors are being integrated with silicon carbide electronics and aluminum nitride energy harvesting devices to build the first instance of a single-chip, self-powered, wireless sensor system. The seminar will begin with a research motivation that examines the actual flows of energy (about 100 exajoules per year) through the United States. This energy flow is approximately 85% derived from the combustion of fossil fuel, and so the seminar proceeds to outline the options for a true high-temperature sensor system (600-1000°C). The seminar then will present a series of visions of sensors that can survive combustion environments, including some prototypes that have survived 600°C, 64,000 g shocks and a jet of dry steam. A number of thin film materials, suitable for fabrication via MEMS methods will be described as candidates for application to this sensor suite. Then, a number of sensors, both existing and under development, will be presented. Integration into silicon carbide electronics will be addressed, and new research results for the fabrication and testing of silicon carbide electronic devices (both active and passive) will be presented. The use of aluminum nitride as a RF component in harsh environments will be described and new results for temperature-compensated radio filters shown. A future vision of a single-chip, self-powered, wireless sensor systems will be described, and a set of conclusions about the future of the technology will be given.