Session 34 - Sensors, MEMS, and Bioelectronics - Micro and Nano-electromechanical Resonant Sensors and Relays
Wednesday, December 11, 9:00 a.m.
Imperial Ballroom B
Co-Chairs: R. Kumar, Globalfoundries
N. Tas, University of Twente

**9:05 AM** **34.1** Phase Change NEMS Relay
James Best, Mohammad Masud, Maarten de Boer, Gianluca Piazza, Carnegie Mellon University

First demonstration of a highly scalable non-volatile mechanical relay (Phase Change NEMS Relay) based on the mechanical expansion of GeTe phase change material. Scaling analysis shows a path towards 20 nm x 5 nm size devices with an actuation voltage and energy of 500 mV and 70 fJ, respectively.

**9:30 AM** **34.2** Ultra-Low-Voltage Operation of MEM Relays for Cryogenic Logic Applications
Xiaoer Hu, Sergio Almeida, Zhixin Ye, Tsu-Jae King Liu, University of California Berkeley

Operation of micro-electro-mechanical relays at temperatures down to 4K is demonstrated for the first time. Due to dramatically reduced hysteretic switching behavior and elimination of contact oxidation, relays can be operated reliably with sub-25mV voltage signals at <100K. This makes them advantageous for digital logic circuits in cryogenic applications.

**9:55 AM** **34.3** Monolithic 180nm CMOS Controlled GHz Ultrasonic Impedance Sensing and Imaging
Mamdouh Abdelmejeed, Amit Lal, Yutong Liu, Adarsh Ravi, Justin Kuo, Jaibir Sharma, Srinivas Merugu, Navab Singh, Cornell University, A*STAR

For the first time we demonstrate monolithically integrated piezoelectric AlN (aluminum nitride) thin film transducers on 180nm CMOS wafers to realize CMOS GHz ultrasonic transducers. The GHz reflectometer pixels are driven by integrated CMOS circuits, to sense different concentrations of electrolytes, and image surface acoustic impedance demonstrated by fingerprint imaging.

**10:20 AM** **34.4** MEMS Resonant Microphone Array for Lung Sound Classification
Hai Liu, Song Liu, Anton Shkel, Yongkui Tang, Eun Sok Kim, University of Southern California

This paper presents piezoelectric MEMS microphone arrays for detection of wheezing in lung sound. Very high unamplified sensitivities of 36.3 – 78.2 mV/Pa have been obtained within frequencies 200-500 Hz where wheezing is typically prominent. Consequently, the wheezing was distinguished better and as high as 97.44% identification accuracy was achieved.

**10:45 AM** **34.5** Extremely High Q AlN Lamb Wave Resonators Implemented by Weighted Electrodes
Anming Gao, Jie Zou, University of Illinois at Urbana-Champaign, University of California Berkeley

This paper presents unprecedentedly high Q AlN S0 Lamb wave resonators achieved by introducing two half-width top interdigitated transducers. The high-Q AlN resonator is experimentally shown with Q of 5500 in room temperature, which is the highest Q ever reported for all reported AlN S0 Lamb wave resonators.

**11:10 AM** **34.6** Galfenol-Ti-Diamond Multilayer MEMS Resonator for Magnetic Sensor Working up to 773 K

Zilong Zhang, Liwen Sang, Haihua Wu, Jian Huang, Linjun Wang, Satoshi Koizumi, Yasuo Koide, Meiyong Liao, National Institute for Materials Science, Shanghai University

We demonstrate a novel high-temperature magnetic sensor based on the hybrid structure of Galfenol/Ti/single crystal diamond (SCD) MEMS resonators up to 773K. The developed magnetic sensor exhibits a stable high-sensitivity and low noise level ~247 pT/√Hz at 773 K, which exceeds those of reported magnetic sensors at high temperatures.