**Q-Boosting of Metal MEMS Resonators via Localized-Anneal Induced Tensile Stress**

Alper Ozgurluk of the Clark T.-C. Nguyen Research Group

The August BSAC Researcher Seminar Series will feature Alper Ozgurluk of BSAC Co-Director Professor Clark T.-C. Nguyen’s group.

Introduction of tensile stress via localized Joule heating has yielded some of the highest metal MEMS resonator $Q$’s measured to date, as high as 48,919 for a 12-MHz ruthenium micromechanical clamped-clamped beam (“CC-beam”). The high $Q$’s continue into the VHF range, with $Q$’s of 7,202 and 4,904 at 61 and 70 MHz, respectively. These marks are substantially higher than the 6,000 at 10 MHz and 300 at 70 MHz previously measured for polysilicon CC-beams, defying the common belief that metal $Q$ cannot compete with conventional micromachinable materials.

The low-temperature ruthenium metal process, with highest temperature of 450°C and paths to an even lower ceiling of 200°C, further allows for MEMS post-processing directly over finished foundry CMOS wafers, thereby offering a promising route towards fully monolithic realization of CMOS-MEMS circuits, such as needed in communication transceivers. This, together with its higher $Q$, may eventually make ruthenium metal preferable over polysilicon in some applications.

Alper joined BSAC as a PhD student in 2012. His research interests include applications of MEMS resonators in timing, sensors, Internet of Things (IoT), and wireless communications. In 2014, he joined BSAC member company Analog Devices as a MEMS Design Engineering Intern. His metal MEMS resonators research earned best student paper award finalist at the IEEE International Frequency Control Symposium in 2017.