The 2020 Around-the-Clock Around-the-Globe Magnetics Conference: Invited speakers information

Name: Amal
Surname: El-Ghazaly
Affiliation: Cornell University
Country: USA

Title of the talk: **Tunable Magnetoelectric Components and Devices**

Biography:
Amal El-Ghazaly is an assistant professor in the department of electrical and computer engineering at Cornell University. Her work combines magnetism, ferroelectricity, and optics to create tunable, versatile electronic systems for telecommunications, sensing and actuation. Prior to joining Cornell in 2019, she was a postdoctoral research fellow at the University of California Berkeley, where she was awarded the University of California President's Postdoctoral Fellowship in 2017. Her postdoctoral research explored new possibilities for ultrafast all-electrical switching of magnetic nanodots for faster and more energy-efficient computer memories. She earned a Ph.D. in electrical engineering from Stanford University, where she was funded by both NSF and NDSEG graduate research fellowships as well as the Stanford DARE fellowship until her graduation in 2016. Her Ph.D. research focused on radio frequency devices using magnetic and magnetoelectric thin-film composites for tunable wireless communications. She received her B.S. and M.S. degrees in electrical and computer engineering from Carnegie Mellon University in 2011.

Abstract:
This seminar presents research that delves into the challenge of engineering devices that are highly versatile and tunable to meet the ever-broadening application demands of the future.

The talk will focus on two ways in which magnetic and piezoelectric materials can be used to make extremely versatile devices with applications in communications, sensing, and haptic interfaces. First, the various types of magnetic materials will be compared in terms of their frequency ranges, advantages, and limitations with respect to applications in communications and sensing [1]. Next, some tricks will be discussed for how reliable high frequency magnetic materials can be produced. To address versatility, magnetoelectric (magnetic and piezoelectric) heterostructures will be presented to provide tunable composite properties [2]. Finally, completely new applications of magnetoelectric composites for haptic interfaces will be discussed. Material composites containing both magnetic and piezoelectric particles will be controlled magnetically such that they actuate into 3D tactile displays and, additionally,

will be sensed electrically to detect tactile pressure on the interface. These concepts, together, demonstrate the importance of materials to the design of broadly versatile devices for future electronics.

References:

[1] El-Ghazaly, A., White, R. M. & Wang, S. X. Gigahertz-band integrated magnetic inductors. *IEEE Trans. Microw. Theory Tech.* 65, 4893–4900 (2017).

[2] El-Ghazaly, A. *et al.* Electrically Tunable Integrated Thin-Film Magnetoelectric Resonators. *Adv. Mater. Technol.* **2**, 1–7 (2017).