Open Lecture of
Research Centre for Smart Wearable Technology

Advanced Ferroelectric Polymers for Wearable Cooling and Haptics

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Qiming Zhang is a Distinguished Professor of Engineering of Penn State University, USA. Research areas in his group cover fundamentals and applications of electronic and electroactive materials, especially piezoelectric and ferroelectric polymers and devices, such as actuators, sensors, transducers, electrocaloric effect and personal cooling, energy storage devices, energy harvesting, polymer film devices and MEMS, electro-optic and photonic devices. Zhang developed a class of electroactive polymers with giant actuation, which formed one key pillar for the electroactive polymer society. The polymers have been commercialized by Arkema. He also founded StrategicPolymers Inc. (now Novasentis, Inc.) which has successfully commercialized the polymer actuators and sensors for haptics and wearable devices. In 2008, he discovered giant electrocaloric effect in polymers, creating unique opportunity for solid state cooling devices with high efficiency and zero green greenhouse gas emission. He has over 450 publications and 21 patents in these areas with an H-index of 79. He is the recipient of the 2008 Penn State Engineering Society Premier Research Award, 2015 Faculty Scholar Medal of Penn State, and 2018 Humboldt Research Award. He is a Fellow of IEEE and a Fellow of APS.

The direct and efficient coupling between the electric signals and the elastic, thermal, optical and magnetic signals in ferroelectrics makes them attractive for exploring a broad range of cross-coupling phenomena which have great promise for new device technologies. This talk will present recent advances in my group on ferroelectric polymers (i) with giant electrocaloric effect for personal cooling and (ii) electroactive polymers for haptics and actuators. Solid-state electrocaloric (EC) cooling technologies, a compact, quiet, efficient, and distributed 21st century technology that emits no greenhouse gases, have the potential to replace vapor compression cooling (VCC), a bulky, noisy, inefficient, and centralized 19th century technology that emits 177 million metric tons of CO_2 per year. Solid-state cooling devices will save energy, improve productivity, protect human health, reduce greenhouse gas emissions, mitigate the impacts of global warming, and enable affordable localized water harvesting/generation which provides access to clean water in the world. For the polymers for the actuators and sensors, I will show that the large electroactuations generated in the polymers enable a broad range of devices applications, such as artificial muscles and haptics.

Date

10 Dec 2018

Time

2:30-3:30 PM

Venue

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