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GaN for Everything

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Abstract: More than two decades after the first demonstration, gallium nitride (GaN) wide bandgap (WBG) semiconductors are revolutionizing an increasing number of applications from power electronics, RF communications, to light-emitting diode (LED) lighting, photovoltaic solar cells, integrated nanophotonics, and more. For example, GaN WBG materials are presently making a significant impact on power electronic devices technologies, which are vital for electric vehicles, data centers, and smart grids. The new power devices based on GaN are expected to outperform the current Si power devices, with promises to trim the losses in power conversion circuits, trip the size, weight and cost of power systems, and overall, drive a 10 percent reduction in global power consumption. At the heart of all these exciting applications is the GaN WBG materials, the unique electronic and optical properties of which have enabled and will continue to enable new paradigms in electronic and photonic technologies. In this talk, I will review our progress on GaN materials research, and discuss their applications in kV-class power transistors (supported by APRAe), high temperature solar cells and memory devices for space missions (supported by NASA), and integrated photonics for quantum information and biochemical sensing applications (supported by ARO). Additionally, I will also discuss the research challenges and opportunities of emerging ultra-wide bandgap (UWBG) materials, including Ga_2O_3, diamond, and AlN, which represent the next frontier in electronic and optical materials. The fundamental questions we are trying to address here are: *What are the limits of GaN devices? Can we see a Si-like roadmap behavior in GaN? And what is the future of WBG technology?*

Speaker: Yuji Zhao is an Assistant Professor of Electrical Engineering at Arizona State University (ASU) and leads the MOCVD GaN Laboratory. He received the Ph.D degree from University of California Santa Barbara (UCSB) in 2012 under the supervision of Nobel Laureate Professor Shuji Nakamura. Dr. Zhao's research interests are materials epitaxy and device engineering of GaN hetero- and nano- structures to electronic and photonic devices. He has authored/co-authored more than 100 journal and conference publications, 2 book chapters, and over 10 patents. Dr. Zhao is the receipt of 2017 ASU Fulton Outstanding Assistant Professor Award, 2016 DTRA Young Investigator Award, 2015 NASA Early Career Faculty Award, 2015 SFAz Bisgrove Scholar Faculty Award, and 2010–2013 UCSB SSLEC Outstanding Research Award.