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Materials Engineering Program
Texas Center for Superconductivity at Univ. of Houston
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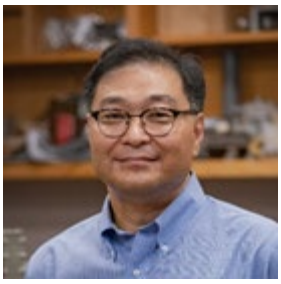
Flexible Electronics Beyond Mechanical Flexibility: Multifunctional Flexible Semiconductor Materials and Devices for Photonic, Electronic, Energy, and Sensing Applications

Jae-Hyun Ryou
Department of Mechanical Engineering
Materials Science and Engineering Program
Texas Center for Superconductivity at the University of Houston
(TcSUH)
Advanced Manufacturing Institute (AMI)
University of Houston

Abstract:
Flexible electronics is an emerging and widely explored area. Most research groups in the area focus on fabrication processes to provide mechanical flexibility and their use in bendable and stretchable applications. Also, most semiconductors employed in flexible electronics are non-single-crystalline thin films which compromise the performance of the flexible devices. Instead of the conventional process and application developments in flexible electronics, my group studies new flexible single-crystalline semiconductor materials and fundamental device physics of the flexible devices. For the new flexible materials, we developed nearly single-crystalline semiconductor thin films directly deposited on polycrystalline tape substrates. For the extension of device physics, we focus on the interaction between mechanical force and device characteristics, such as changes in electronic band structures, mobilities of free carriers, and quantum efficiencies of energy conversion. The presentation will cover various topics of flexible photonic, electronic, energy, and sensing devices. The new functionality of flexible devices, material-related technical issues, and state-of-the-art device technology will be described. Specifically, research topics to be presented include (1) direct growth of high-quality single-crystal-like semiconductor thin films of GaAs and GaN on low-cost flexible metal tapes, (2) flexible high-performance photovoltaic solar cells and high-electron-mobility transistors on the metal tapes, (3) active piezoelectric polarization engineering of flexible Group III-nitride heterostructures and their electronic and photonic devices for quantum efficiency improvement and device characteristics tunability, and (4) flexible piezoelectric energy harvesters and sensors for self-powered wearable healthcare monitoring systems such as power generators, and pulse sensors and eye-movement sensors.



Short Bio: Jae-Hyun Ryou received the B.S. and M.S. degrees in Metallurgical Engineering from Yonsei University, Seoul, Korea, and the Ph.D. degree in Materials Science and Engineering in the area of solid-state materials from the University of Texas at Austin, Austin, TX. Before joining the University of Houston, he had several R&D positions in both industry and academia, including Honeywell Technology Center, Honeywell VCSEL Optical Products, Center for Compound Semiconductors at Georgia Institute of Technology. With research interests in semiconductor materials, nanostructures, and quantum devices, he has been developing new-concept material structures and devices for photonic, electronic, energy, and sensing applications through materials/device structure modeling/design, epitaxial materials growth by chemical vapor deposition and physical vapor deposition, and fabrication process innovations. He has authored or co-authored 6 book chapters of books, >200 technical journal papers, and >280 conference presentations, and holds 12 U.S. patents. He is a member of the Materials Research Society (MRS) and a senior member of the Institute of Electrical and Electronics Engineers (IEEE) and the Optical Society of America (OSA). He served as an associate editor of Optics Express of the OSA.