Department of Electrical and Computer Engineering

TEXAS TECH UNIVERSITY
Edward E. Whitacre Jr.
College *of* Engineering™

Fall 2023 Seminar Series

Seminar Title: ***Nanometer-scale III-V Transistors: From THz to CMOS***

Time: 2:00-2:50 PM, Friday, Nov 10, 2023

Location: Biology 101

Speaker:
Taewoo Kim
ECE Department, TTU

Abstract:
Over the last 30 years, Si CMOS scaling has been the cornerstone of the microelectronic revolution. While it remains a matter of considerable debate, the semiconductor device technology that fuels this microelectronics revolution appears to be reaching the end of its use. The attention that propelled CMOS to experience the exponential growth in density, power, and speed that underpins Moore's law is quickly waning. This looming scenario has spurred interest in identifying alternative transistor technologies with performance potential that substantially improve upon Si CMOS. Among these, III-V and III-nitride compound semiconductors are strong candidates. With room temperature bulk electron mobilities that span from approximately 7,000 cm2/V-s for GaAs to about 30,000 cm2/V-s for InSb, these materials promise a significant enhancement in electron velocity that can no longer be obtained from Si. Among the III-Vs and III-nitride semiconductors, indium gallium arsenide (InGaAs) devices that contain compositions closely lattice-matched to InP appear rather unique. With an electron mobility that exceeds 10,000 cm2/V-s at 300 K and a rather mature processing technology, InGaAs transistors are based on InP and include heterostructure-bipolar-transistors (HBTs) and high-electron-mobility-transistors (HEMTs); they have held the record frequency response for the highest-cut-off frequency (fT) transistors for nearly 20 years. In addition, GaN-based HEMTs have excellent breakdown characteristics in terms of DC and RF applications. HEMTs are suitable for high-power applications and have been extensively used to demonstrate > 100 GHz and > 100 Gb/s communication ICs with SSI-level complexity and reasonable reliability. Therefore, InGaAs and GaN represent the best balance between performance and maturity. This talk will summarize recent progress in our quest to map out the potential of III-V compound semiconductor for logic, identify issues of relevance to future III-V and III-Nitride transistors for high frequency and quantum computing applications, and propose innovative schemes to realize III-V/III-Nitride on Si by means of "Heterogeneous Integration".

Speaker Bio:
Dr. Kim completed a major in Electrical Engineering and Computer Science, and then went on to earn a Ph.D. from the Gwangju Institute of Science and Technology in South Korea in August 2008. After that, Dr. Kim worked as a postdoctoral research associate at the Massachusetts Institute of Technology (MIT) for three years. Following that, Dr. Kim joined SEMATECH, INC., where responsibilities included overseeing III-V CMOS development, including non-planar FinFET, TFET, and vertical nanowire MOSFETs for future high-speed and logic applications. In next role, Dr. Kim worked at Samsung Austin Semiconductor where he led the 14-nm FEOL module team in the process integration group. Currently, Dr. Kim is an Assistant Professor at Texas Tech University. His research accomplishments include five outstanding academic research awards/honors, 80 international presentations, 80 international publications, and one book chapter.