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Transistor, from the fundamentals of MOSFET toward "3D" nanoTransistor

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Abstract: A transistor is the essential building unit in every electronic device. A transistor has revolutionized the digital world like the finest grain. A modern digital IC (Integrated Circuit) chip predominantly employs a Metal-Oxide-Semiconductor Field-Effect Transistor (i.e. MOSFET), and CMOS (Complementary MOS) to mass-produce a digital IC chip. In this talk, the fundamental working principle of MOSFET is discussed. Then, the physical structure of MOSFET is distinctly explored, accompanying by the essential semiconductor fabrication processes, which allow us to clearly understand the major electronic operations of MOSFET, mainly utilized for signal amplification and digital switching in modern electronics. However, conventional bulk MOSFET on device size reduction has suffered from the leakage current causing significant power consumption, which is considered as one of the short channel effects. Parasitic RC delay in a transistor degrades the performance of the transistor circuit on the speed and timing accuracy. To overcome the pitfalls of conventional MOSFET in deep sub-micron scale, the novel materials (e.g. HEMT, carbon nanotube, and graphene) and a three-dimensional transistor (e.g. multigate-FET, FinFET) including countermeasures will be briefly introduced.

Bio: Taerin Chung received a Ph.D. degree from the school of Electrical Engineering at Seoul National University, Korea in 2014. She received the M.E. degree from the Department of Electrical and Computer Engineering at Cornell University, Ithaca, NY, in 2008. She also received the M.S. degree from the Department of Electronic and Electrical Engineering at POSTECH, Korea, in 2003. She worked at the Semiconductor R&D division in Samsung Electronics, Co. from 2003 to 2004. She was a postdoctoral research associate at the University of Southern California from 2015 to 2016 and at UCLA in 2014. Then, she was a research assistant professor in the Department of Bio and Brain Engineering, Korea Advanced Institute of Science and Technology from 2017 to 2018. She was a researcher and research scientist in the Institute of Quantitative Biomedicine, Rutgers from 2019 to 2020 and in Tech4Health Institute, the Grossman school of Medicine, New York University from 2021 to 2022, respectively. Currently, she is a lecturer in the ECE department, Rutgers University. She has authored and co-authored over 40 scientific contributions in peer-reviewed journal papers, conference proceedings, and book chapter. Her research interests are nanophotonic/optic biosensors, advanced display technology, photonic circuits, and advanced micro/nano-fabrication including novel semiconductor/photonic materials.