Large-scale Fabrication of MoS₂ and PtSe₂ MOSFETs for Future-Generation Thin-Film and Flexible Electronics

Abstract: Two-dimensional (2D) atomic layered materials such as MoS₂ and PtSe₂ are promising for future-generation thin-film electronics that can operate at gigahertz frequencies. This is because the carrier mobility in MoS₂ and PtSe₂ can be on the order of 100 cm²/Vs and 1,000 cm²/Vs, respectively, without epitaxy. However, to date most 2D MOSFETs were individually crafted on small flakes exfoliated from bulk materials by using direct-write electron-beam lithography, and their feasibility for large-scale, low-cost fabrication using conventional semiconductor fabrication techniques such as sputtering and photolithography has not been established. Recently, we demonstrated large-scale fabrication of MoS₂ and PtSe₂ MOSFETs using the back-end-of-line (BEOL) process of a state-of-the-art CMOS line. The BEOL process allowed deep-submicron Al gates to be buried flat in SiO₂ on high-resistivity Si, and high-quality gate oxide to be grown before transfer or synthesis of 2D materials.

Biography: Dr. James Hwang is Professor of Electrical Engineering at Lehigh University. He graduated with a B.S. degree in Physics from National Taiwan University, and M.S. and Ph.D. degrees in Materials Science from Cornell University. After twelve years of industrial experience at IBM, Bell Labs, GE, and GAIN, he joined Lehigh in 1988. He cofounded GAIN and QED; the latter became a public company (IQE). He has been a visiting professor at University, East China Normal University, and University of Science and Technology in China, Nanyang Technological University in Singapore, and Marche Polytechnic University in Italy. Most recently, he was a Program Officer for GHz-THz Electronics at the US Air Force Office of Scientific Research. He is a Life Fellow of the Institute of Electrical and Electronic Engineers. He has published approximately 350 refereed technical papers with the impact factor $h > 40$ according to Google Scholar. He has been granted eight U. S. patents. He has researched on the design, modeling and characterization of microwave, optical and micro-electromechanical (MEM) devices and integrated circuits.
Large-scale Fabrication of MoS$_2$ and PtSe$_2$ MOSFETs for Future-Generation Thin-Film and Flexible Electronics