Notice and Invitation
Oral Defense of Doctoral Dissertation
College of Engineering and Computing
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Effects on 2D TMDS and Monolayer FETs with PN-Junction or Heterojunction Channels
Friday, May 12, 2023, 1:30 PM-2:30PM
The Buchanan Hall Conference Room, D217A
All are invited to attend.

Committee
Dr. Qiliang Li, Chair
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Abstract

The major challenges in the scaling of metal-oxide-semiconductor field effect transistors (MOSFETs) include large source-to-drain leakage and small on/off current ratio, especially when the channel length is below 10nm. As the devices are being shrunk into nanoscale, it is increasingly difficult, if not impossible, to precisely control the dopant position and number in low-dimensional nanomaterials. To address these challenges, we designed and investigated a new type of short-channel FETs based on two-dimensional (2D) transition metal dichalcogenides (TMDCs) with a PN junction or heterojunction at the middle of the channel. The first step is to investigate the doping effects on the electrical properties of n-type and p-type 2D TMDCs, like MoS_2 monolayer. In the comprehensive first-principle computational study of 2D TMDC FETs, different gate length and channel materials have been investigated and compared, with a focus on the analysis of ballistic transport, energy band alignment and their impact on channel current density. The results indicate that the off-state leakage current and on/off current ratio are significantly improved in the FETs with a junction channel, in comparison with the FETs with homogeneous channel. Also, the 2DTMDC semiconductors should be protected from unintentional or intentional doping if they are used in the transistors in future integrated circuits. This new junction-channel approach, leveraged with the intrinsic advantages offered by 2D TMDC monolayers, suggests a new and very attractive strategy to construct future nanoelectronic transistors.