Session 5: Nano Device Technology – 2D Devices
Monday, December 15, 1:30 p.m.
Continental Ballroom 4
Co-Chairs: Joerg Appenzeller, Purdue University
Max Lemme, Siegen University

1:35 p.m.
5.1 Contact Resistance Reduction using Fermi Level De-pinning Layer for MoS_2 FETs, W. Park, Y. Kim, S.K. Lee, U. Jung, J.H. Yang, C. Cho, Y.J. Kim, S.K. Lim and B.H. Lee, Gwangju Institute of Science and Technology

Achieving a low contact resistance is an important challenge in 2D material devices. In this study, a low contact resistance for MoS_2 FETs was achieved using Fermi level de-pinning interlayer. The value of contact resistance is ~5.4 kΩ•μm which is ~5 times higher than devices without interlayer. Drain current and total resistance were also compared between with and without interlayer and an enhancement was observed. This result might be due to the barrier height decrease and dipole effects at the contact area. This interlayer technology can be a practical contact technology for 2D devices.

2:00 p.m.
5.2 Towards High-Performance Two-Dimensional Black Phosphorus Optoelectronic Devices: the Role of Metal Contacts, Y. Deng, N. Conrad, Z. Luo, H. Liu, X. Xu and P. Ye, Purdue University

In this paper, we try to shed a light on the role of various metal contacts on BP FETs and photodetectors. The work function of metal plays an important role on the hole/electron conductions at the contact. FET with larger work functions metals as contacts exhibit larger hole current, while ambipolar characteristics can be observed on devices with lower work function metals. A photodetector with a record high photoresponsivity (223 mA/V) is demonstrated on BP through contact engineering.

2:25 p.m
5.3 Atomically Thin Graphene Plane Electrode for 3D RRAM, J. Sohn, S. Lee, Z. Jiang, H.-Y. Chen and H.S.P. Wong, Stanford University

3Å thick graphene was employed in the vertical RRAM structure to drastically reduce total stack-height to a single atomic layer. Two-layer 3D-stacked HfO_x RRAM with graphene planar electrode is demonstrated in a 3D cross-point architecture with the edge of the graphene plane electrode serving as the bottom electrode of RRAM.

2:50 p.m.
5.4 Graphene Inductors for High-Frequency Applications – Design, Fabrication, Characterization, and Study of Skin Effect, X. Li, J. Kang, X. Xie, W. Liu, D. Sarkar, J. Mao* and K. Banerjee, University of California, Santa Barbara, *Shanghai Jiao Tang University

Graphene is very attractive for densely integrated and flexible high-frequency applications due to its extraordinary electrical, thermal, and mechanical properties. This work presents the design, fabrication, and characterization of graphene on-chip inductors. The skin effect in graphene inductors is investigated experimentally for the first time based on a circuit model proposed and fitted from fabricated 3/4-, 2-, and 3-turn inductors. The operation frequencies are in 40-60 GHz range and Q-factors are around 3. Design and fabrication optimizations are performed to guide future studies.

3:15 p.m.
5.5 Nanophotonics with two-dimensional atomic crystals, T. Mueller Vienna University of Technology

Two-dimensional (2D) atomic crystals, such as graphene and atomically-thin transition metal dichalcogenides (TMDCs), are currently receiving a lot of attention. These materials are crystalline, and thus of high material quality and stability. Even so, they can be produced in large area dimensions and at low cost, making them attractive for a variety of applications in electronics and photonics. In addition, the possibility of stacking individual atomic monolayers on top of each other provides the opportunity of creating new “artificial” materials – so-called van der Waals (vdW) heterostructures. In this talk, I will review our recent work on photodetection, light emission and photovoltaic energy conversion in 2D crystals and vdW heterojunctions.

3:40 p.m.

5.6 Broadband 10Gb/s Graphene Electro-Absorption Modulator on Silicon for Chip-Level Optical Interconnects, Y. Hu*, M. Pantouvaki, S. Brems, I. Asselberghs, C. Huyghebaert, M. Geisler*, C. Alessandri, R. Baets*, P. Absil, D. Van Thourhout* and J. Van Campenhout, IMEC, *Ghent University – IMEC

We report the first silicon integrated graphene optical electro-absorption modulator capable of 10Gb/s modulation speed. We demonstrate low insertion loss and low drive voltage combined with broadband and athermal operation in a compact hybrid graphene-Si device, outperforming Si(Ge) optical modulators for future chip-level optical interconnect applications.

4:05 p.m.

5.7 Fast Visible-Light Phototransistor Using CVD-Synthesized Large-Area Bilayer WSe_2, P.-S. Liu, C.-H. Chen*, W.-T. Hsu**, C.-P. Lin, T.-P. Lin, L.-J. Chi, C.-Y. Chang, S.-C. Wu, W.-H. Chang**, L.-J. Li* and T.-H. Hou, National Chiao Tung University, *Academia Sinica, **National Chiao Tung University

P-channel metal dichalcogenide ultrathin-body phototransistor (UTB-PT) with a response time as fast as 100 us has been demonstrated for the first time, using the CVD-synthesized large-area bilayer WSe_2. Because of its excellent compatibility with mass production, the application of WSe_2 UTB-PT for high-speed proximity interactive display has been proposed.