Proceeding (E-Program Book)

The 12th Recent Progress in Graphene and Two-dimensional Materials Research Conference

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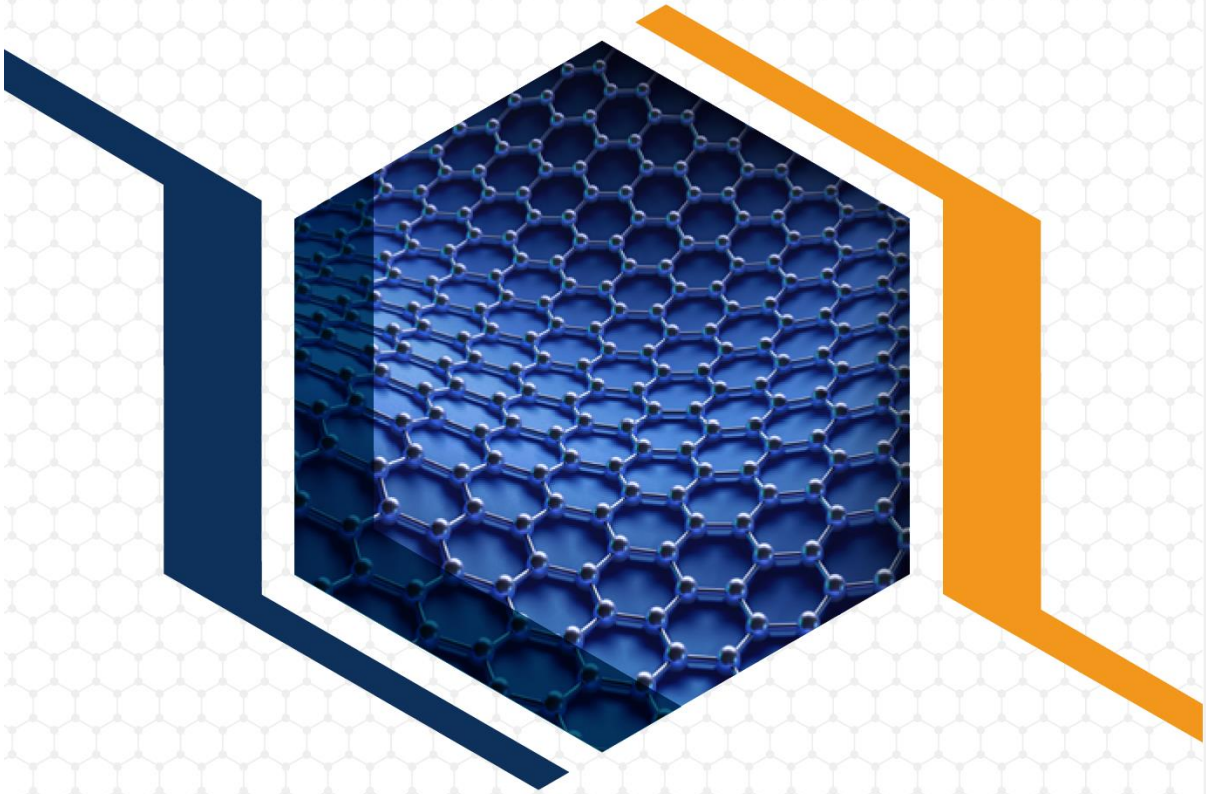

Hosted by Korean Graphene Society 한국그래핀학회

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CSEED 다차원 나노조립제어 창의연구단 vdWMRC 국제협력융합바이오연구소 PRECISION BIOLOGY RESEARCH CENTER YONSEI UNIVERSITY ELECTRICAL & ELECTRONIC ENGINEERING

BK21 Y-BASE R&E Institute

TS3. Electronics, Optoelectronics & Other Devices — Ballroom A(B1F)

Technical Session #8 — Chair : Hongseok Oh (Soongsil University, Korea)

I-TS3-0420 13:00-13:30
(Invited) Heterojunctions of 2D Materials for High-Performance Electronic and Optoelectronic Devices
Hyeok Jun Jin(Korea Advanced Institute of Science and Technology, Korea), Cheolmin Park(Korea Advanced Institute of Science and Technology, Korea), Khang June Lee(Korea Advanced Institute of Science and Technology, Korea), Gwang Hyuk Shin(Korea Advanced Institute of Science and Technology, Korea), Sung-Yool Choi(Korea Advanced Institute of Science and Technology, Korea)*

C-TS3-0231 13:30-13:45
Magneto-transport properties of the V5Se8/NbSe2 van der Waals heterostructures
Hideki Matsuoka(RIKEN, Japan), Masaki Nakano(The University of Tokyo, Japan)*, Stewart Edward Barnes(University of Miami, United States), Jun'ichi Ieda(JAEA, Japan), Sadamichi Maekawa(RIKEN, Japan), Mohammad Saeed Bahramy(University of Manchester, United Kingdom), Bruno Kenichi Saika(The University of Tokyo, Japan), Yukiharu Takeda(JAEA, Japan), Hiroki Wadati(University of Hyogo, Japan), Yue Wang(The University of Tokyo, Japan), Satoshi Yoshida(The University of Tokyo, Japan), Kyoko Ishizaka(The University of Tokyo, Japan), Yoshihiro Iwasa(The University of Tokyo, Japan)

C-TS3-0143 13:45-14:00
Anisotropic carrier transport of black phosphorus using 2D surface and 1D edge contacts
Myeongjin Lee(Sungkyunkwan University, Korea), Nasir Ali(Sungkyunkwan University, Korea), Hyokwang Park(Sungkyunkwan University, Korea), Won Jong Yoo(Sungkyunkwan University, Korea)*

C-TS3-0273 14:00-14:15
Thermal energy harvesting using graphene based ballistic rectifier with diode bridge geometry
Dinh Cong Nguyen(Sejong University, Korea), Minwook Kim(Sejong University, Korea), Van Huy Nguyen(Sejong University, Korea), Yongho Seo(Sejong University, Korea)*

C-TS3-0279 14:15-14:30
Coulomb drag in graphene FETs with the ballistic electron injection
Victor Ryzhii(Tohoku University, Japan)*, Maxim Ryzhii(University of Aizu, Japan), Vladimir Mitin(University at Buffalo, United States), Michael Shur(Rensselaer Polytechnic Institute, United States), Taiichi Otsuji(Tohoku University, Japan)

C-TS3-0133 14:30-14:45
Probing Interface Trap Density in layered-WSe2 and Their Impact on Device Characteristics
Fida Ali(Sungkyunkwan University, Korea), Muhammad Taqi(Sungkyunkwan University, Korea), Tien Dat Ngo(Sungkyunkwan University, Korea), Nasir Ali(Sungkyunkwan University, Korea), Myeongjin Lee(Sungkyunkwan University, Korea), Won Jong Yoo(Sungkyunkwan University, Korea)*

C-TS3-0201 14:45-15:00
Hot electron relaxation in MoS2and WSe2field-effect transistors
Jinshu Li(Sungkyunkwan University, Korea), Qi Zhang(Sungkyunkwan University, Korea), Kanyamon Thaikun(Sungkyunkwan University, Korea), Euyheon Hwang(Sungkyunkwan University, Korea)*

Thermal energy harvesting using graphene based ballistic rectifier with diode bridge geometry

Dinh Cong Nguyen[1], Minwook Kim[1], Van Huy Nguyen[1], Yongho Seo[1,*]

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Graphene has been studied for a ballistic rectifier with zero threshold voltage as it has a long mean free path close to a micrometer at room temperature. In this study, a ballistic rectifier based on graphene encapsulated with hexagonal boron nitride was demonstrated with a diode bridge structure. The diode bridge circuit made by graphene channel provided a ballistic current path for the continuous and effective ballistic motions of the electrons and holes. Its unique geometry combined with the tapered and tilted geometric effects enabled the device to rectify small signals (<100 μV) with an excellent performance. The rectification responsivities were estimated at 38,000 V/W for holes and 23,000 V/W for electrons at room temperature, which are among the highest values reported to date. Due to zero threshold voltage of the device, Johnson noise signals generated at a metal resistor were rectified at room temperature. In other words, thermal excitation energy was converted to electrical energy at room temperature. The bandwidth of the device was estimated at ~ 1.1 GHz for holes and 2 GHz for electrons at the ballistic regime. The device developed in this study is believed to be a critical step for a paradigm shift of energy harvesting source from mechanical vibration to thermal energy.

References

1. D. C. Nguyen, M. Kim, M. Hussain, V. H. Nguyen, Y. Lee, D. Kang, S. Kumar, J. Jung, Y. Seo, Preprint from Research Square, PPR: PPR340997, **(2021)**