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Title of the Presentation: Barristor-based sensor platform with extreme sensitivity

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Short Biography:

In 2005, he received Ph. D degree in Seoul National University, Korea. Then, he moved to Korea research institute of standard science as a postdoctoral researcher. Since he joined Samsung Advanced Institute of Technology in 2006, where he initiated graphene research, he has conducted research in graphene electronics. Based on the research, he co-authored a review article in Nature with the president of Samsung Advanced Institute of Technology. To solve the well-known switching problem of graphene transistor, he invented a new electronic device, modulating the graphene-Si Schottky-barrier height, published in Science. He named the device "barristor," meaning barrier transistor, since the current can be modulated by modulating the Schottky-barrier. Then he moved to Konkuk University in 2013 and conducted research to discover the barristor's potential and limitations. To discover the potential, he is now conducting research on the graphene electronic device as a sensor framework.

Abstract:

Since graphene has unique properties such as unprecedently high electron mobility up to 140,000 cm2/V·s and extreme sensitivity to accumulated charge on the graphene, it has been in the spotlight for years. Thus, the graphene has been adopted as a novel channel material of field-effect transistor (FET) as a sensor platform since graphene detects gas, DNA, antigen and even photon when the graphene is coated with quantum dots. However, owing to graphene FET's low switching ratio (I_{ON}/I_{OFF}), the sensitivity of the sensors has not been satisfied.

In this talk, a new sensor platform will be suggested, by adopting barristor structure [1], instead of the FET structure. The experiments exhibit that the platform has extreme sensitivity. The barristor-based DNA sensors could detect 1 aM with ~ 100 % sensitivity and separate 1 base-pair error. The barristor-based gas sensor could detect 25-ppb of NO_2 with 1000 % sensitivity and the sensitivity could be projected to detect sub-ppb. Finally, the origin of the extreme sensitivity and the potential of the platform will be discussed.

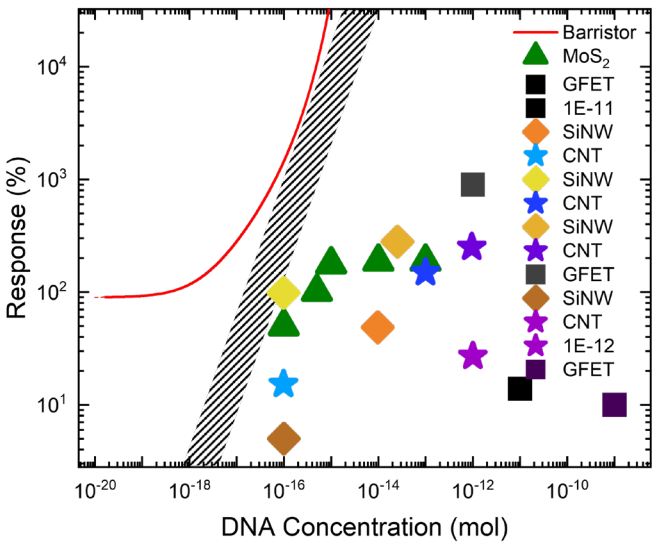

Fig. 1. Sensitivity of graphene barristor and various transistors using graphene, carbon nanotubes, and Si nanowires.

[1] H. Yang, et al., Science. 336, 1140–1143 (2012).
[2] J. Lee et al., Nature Commun. 12, 1000 (2021).