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Extremely Wide Detection Range MoS_2 Phototransistor for use Novel Light Detecting Mechanism

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We have developed the MoS_2 phototransistors using Ge back gate electrode, which can detect the infrared light using a novel light detecting mechanism in MoS_2 phototransistors for the first time. Since the phototransistor can detect the visible light as same as typical MoS_2 phototransistor, the MoS_2 phototransistor with Ge back gate has a considerable wide detection range from visible to infrared. The mechanisms of detection in visible light and infrared light have been successfully investigated. The infrared detection has been verified by the comparison between Si and Ge back gate electrodes. In the infrared light, the phototransistor operates by the mechanism of threshold voltage shifts through modification of band bending at the Ge-SiO_2 interface caused by accumulated electrons, and the values are from -0.432 to -0.212 V. This novel light detecting mechanism can be applied to all TMDs-based phototransistors regardless of the channel materials because the back gate absorbs the infrared light, not the channel region. When the infrared light is incident, the rising and decaying times are 0.1 ms and 45 ms, respectively. The temporal response with the visible light is similar to the previously developed MoS_2 phototransistors, however, in the infrared light, the MoS_2 phototransistor in this work exhibits very fast operation speed. Furthermore, the Vth shift depending on the incident infrared light can be tunable through the SAL doping on MoS_2. According to these advantages, the MoS_2 phototransistors with the Ge gate are expected to be used for next generation phototransistor in the optoelectronic platform.

Biography:

Seung-Geun Kim received his B.S. degree in Materials Science and Engineering from Korea University, Seoul, South Korea, in 2016. He is currently pursuing his Ph.D. degree in Department of Semiconductor Systems Engineering from Korea University. His current research interests include optoelectronics and CMOS technology.