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Research highlights

High photosensitivity few-layered $MoSe_2$ back-gated field-effect phototransistors

Two-dimensional (2D) layered materials are now attracting a lot of interest due to their unique optoelectronic properties at atomic thicknesses. Among them, graphene has been mostly investigated, but the zero-gap nature of graphene limits its practical applications. Therefore, 2D layered materials with intrinsic band gaps such as MoS_2, $MoSe_2$, and $MoTe_2$ are of interest as promising candidates for ultrathin and high-performance optoelectronic devices.

Here, Pil Ju Ko and colleagues at Toyohashi University of Technology, Japan have fabricated back-gated field-effect phototransistors made of $MoSe_2$ crystals having a thickness of only twenty nanometers. The devices were fabricated by mechanical cleavage of $MoSe_2$ crystals into few-layered flakes, followed by transfer onto a silicon wafer with pre-deposited titanium electrodes.

Despite their ultra-thin physical size, the devices showed excellent field-effect phototransistor characteristics. The measured photoresponsivity of 97.1 AW^{-1} at zero back gate voltage was higher than previous reports of photodetectors fabricated using GaS, GaSe, MoS_2, and InSe. The photoresponse of the $MoSe_2$ was much faster (less than 15 msec) than ultrasensitive photodetectors based on monolayer MoS_2. Furthermore, the theoretical external quantum efficiency was 280-fold higher than of commercial Si and InGaAs photodiodes.

The research shows that $MoSe_2$ is a promising material for photodetector applications. The group is optimization the device performance by studying thickness-dependent of the photosensitivity.

Reference:

- Authors: Abdelkader Abderrahmane, Pil Ju Ko, Tran Viet Thu, Shunji Ishizawa, Tsukasa Takamura and Adarsh Sandhu.
- Title of original paper: High photosensitivity few-layered $MoSe_2$ back-gated field-effect phototransistors.
- Journal, volume, pages and year: *Nanotechnology* **25** 365202 (1-5) (2014).
- Digital Object Identifier (DOI): 10.1088/0957-4484/25/36/365202.
- Affiliations: Electronics-Inspired Interdisciplinary Research Institute (EIIRIS) and Department of Electrical and Electronic Information Engineering, Toyohashi University of Technology, 1-1 Hibarigaoka, Tempaku, Toyohashi, Aichi 441-8580, Japan
- Department website: http://www.sandhu.jp/

Pil Ju Ko

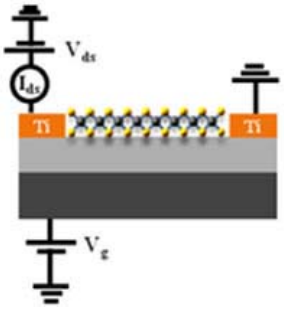

Fig.1: Schematic structure of the few-layered $MoSe_2$ FETs.

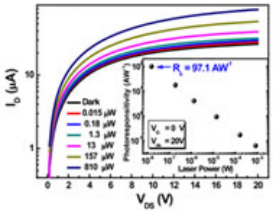

Fig.2:Laser power dependence of the drain current versus the drain-source voltage at zero gate voltage. Inset: photoresponsivity extracted from the I_d-V_{ds} characteristic.