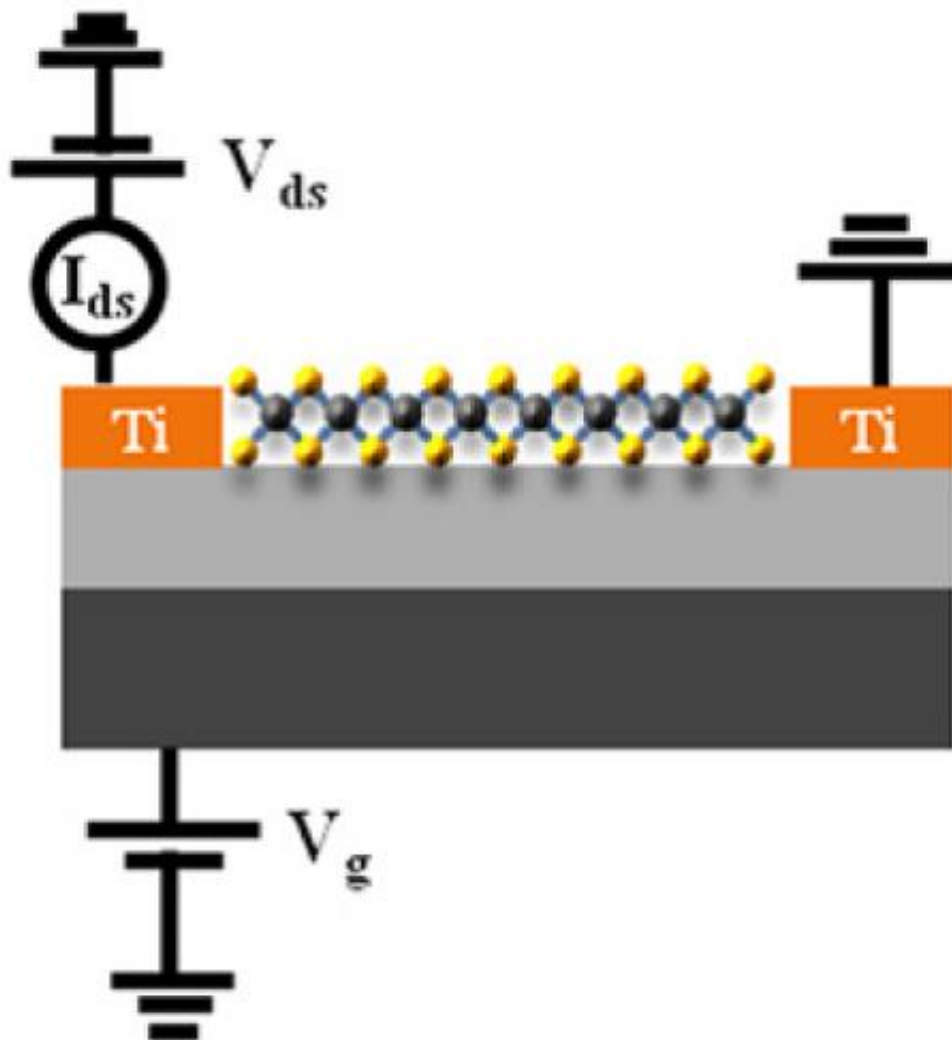


High photosensitivity 2-D-few-layered molybdenum diselenide phototransistors

December 8 2014



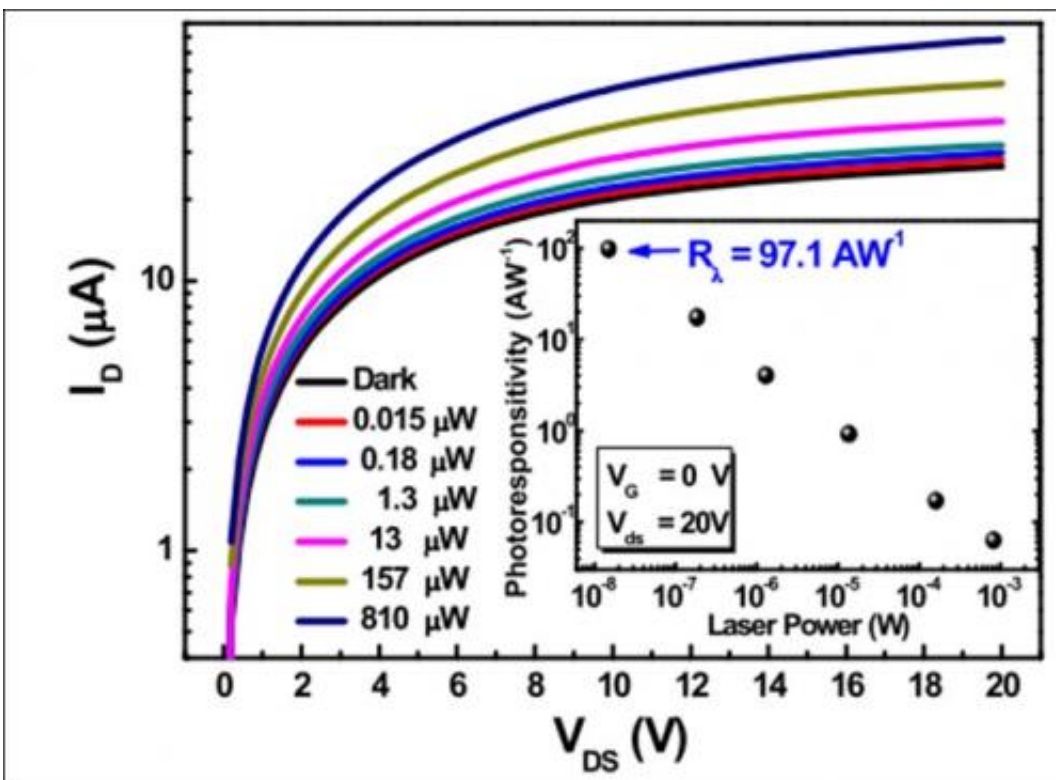
Schematic structure of the few-layered MoSe₂ FETs. Credit: (c) 2014 Toyohashi University of Technology

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 MoS₂, MoSe₂, and MoTe₂ 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 MoSe₂ crystals having a thickness of only twenty nanometers. The devices were fabricated by mechanical cleavage of MoSe₂ 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, MoS₂, and InSe. The photoresponse of the MoSe₂ was much faster (less than 15 msec) than ultrasensitive photodetectors based on monolayer MoS₂. Furthermore, the theoretical external quantum efficiency was 280-fold higher than of commercial Si and InGaAs photodiodes.

The research shows that MoSe₂ is a promising material for photodetector applications. The group is optimization the [device](#) performance by studying thickness-dependent of the photosensitivity.



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. Credit: (c) 2014 Toyohashi University of Technology

More information: Abdelkader Abderrahmane, Pil Ju Ko, Tran Viet Thu, Shunji Ishizawa, Tsukasa Takamura and Adarsh Sandhu, High photosensitivity few-layered MoSe₂ back-gated field-effect phototransistors, *Nanotechnology* 25 365202 (1-5) (2014). [DOI: 10.1088/0957-4484/25/36/365202](https://doi.org/10.1088/0957-4484/25/36/365202)

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