Mechanisms of photoconductivity in atomically thin InSe and GaSe

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The layered III-VIA semiconductors family has attracted large interest recently and many applications based on these materials have been reported, such as single-photon emitters working at room temperature and strong optical non-linearity [1]. In this talk I will discuss our recent experimental efforts in explaining the mechanisms behind the photocurrent generation in photodetectors based on GaSe and InSe. We find that both materials react with air and we observe a change in their responsivity and speed of operation sign of a competition between photogating and photoconductive effect [2,3]. These observations can be explained by the presence of traps in the system, mostly associated with selenium vacancies that can interact with the oxygen present in the air and influence the generation of photocurrent. Interestingly while in GaSe the interaction with air leads to the failure of devices in a few days, in InSe the degradation process is a self-limiting process and the devices are stable in air for months.

References

[1] P Tonndorf, S Schwarz, J Kern, I Niehues, O Del Pozo-Zamudio, A I Dmitriev, A Bakhtinov, D N Borisenko, N N Kolesnikov, A I Tartakovskii, 2D Materials, 4 (2017) 021010.

[2] Q Zhao, R Frisenda, P Gant, D Perez de Lara, C Munuera, M Garcia-Hernandez, Y Niu, T Wang, W Jie, A Castellanos-Gomez, Advanced Functional Materials, 28 (2018) 1805304.

[3] Q Zhao, T Wang, W Jie, A Castellanos-Gomez, R Frisenda, submitted to Advanced Functional Materials (2019).

Figures

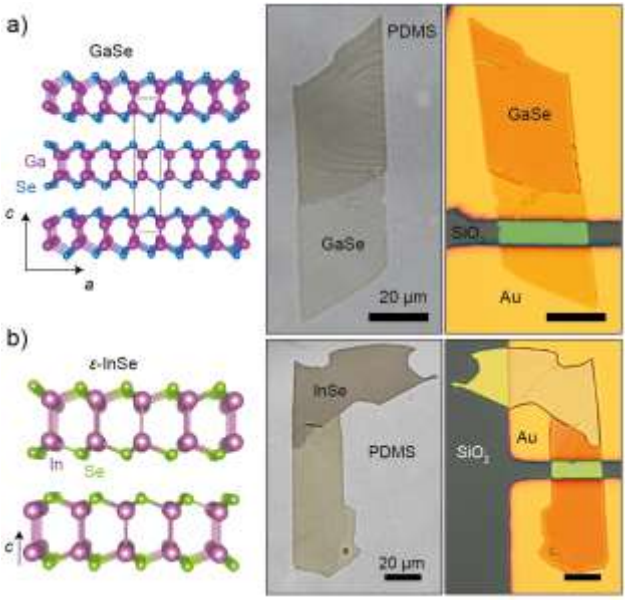

Figure 1: a) Crystal structure of GaSe (left), optical pictures of a thin GaSe flake and of the final photodetector device (right). b) Same as (a) for InSe.