Air passivation effect on two-dimensional InSe crystals and design for high-quality Schottky junctions

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Defect related functionalization of semiconductors is a very important route to optimize the material properties and device performance. Unfortunately, in nanomaterials and in particular in 2D materials, the traditional bulk semiconductor defect engineering/doping methods (like annealing) usually cannot be directly transferred. In the post-growth stage, gas molecular doping is a popular way to tune the properties in 2D semiconductors. The presence of defects, such as chalcogen atom vacancies in chalcogen-based 2D semiconductors, offers a complementary platform to realize the functionalization of these 2D materials and tune their optoelectronic properties. Here, we demonstrate that the interaction with oxygen species present in air can cure electronically active defects in InSe, a novel and promising 2D semiconductor, and tune the performances of photodetecting devices based on this material from high responsive configurations to fast responding ones [1]. Both the intrinsic material doping and the metal electrode-2D semiconductor interface modification can be realized by the healing of chalcogen vacancies in air. More interestingly, the high quality of the metal-semiconductor interfaces obtained by van der Waals contact allows fabricating high-quality Schottky diodes based on the metal (Au/Pt)–InSe Schottky barrier [2,3]. Our results demonstrate that trap state modulation can be an important tuning knob for thin InSe in the field of electronics and optoelectronics.

References

[1] Zhao Q, Wang W, Carrascoso-Plana F, et al. The role of traps in the photocurrent generation mechanism in thin InSe photodetectors[J]. Materials Horizons, 2020, 7(1): 252-262.
[2] Zhao Q, Jie W, Wang T, et al. InSe Schottky diodes based on van der Waals contacts[J]. Advanced Functional Materials, 2020, 30(24): 2001307.
[3] Zhao Q, Peng C, Dan Z, et al. Multifunctional Indium Selenide devices based on van der Waals contacts: high-quality Schottky diodes and optoelectronic memories[J]. Nano Energy, 2022, Accpeted.