Environmental degradation of 2D GaSe photodetectors

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Abstract

Gallium selenide (GaSe) is a novel two-dimensional material, which belongs to the layered III-VIA semiconductors family and attracted interest recently as it displays single-photon emitters at room temperature and strong optical non-linearity.[1,2,3] Nonetheless, few-layer GaSe is not stable under ambient conditions and it tends to degrade over time. Here I will discuss optoelectronic measurements of thin GaSe photodetectors to study the long-term stability.[4] We found that the GaSe flakes exposed to air tend to decompose forming firstly amorphous selenium and Ga_2Se_3 and subsequently Ga_2O_3. While the first stage is accompanied by an increase in photocurrent, in the second stage we observe a decrease in photocurrent, which leads to the final failure of GaSe photodetectors. Additionally, we found that the encapsulation of the GaSe photodetectors with hexagonal boron nitride (h-BN) can protect the GaSe from degradation and can help to achieve long-term stability of the devices.

References

[1] P. Tonndorf, S. Schwarz, *et al.*, 2D Materials, 4 (2017) 021010
[2] X. Zhou, J. Cheng, *et al.*, Journal of the American Chemical Society, 137 (2015) 7994
[3] W. Jie, X. Chen, et al., Angewandte Chemie International Edition, 54 (2015) 1185
[4] Zhao Q, Frisenda R, et al., Advanced Functional Materials, 28(47) (2018) 1805304

Figures

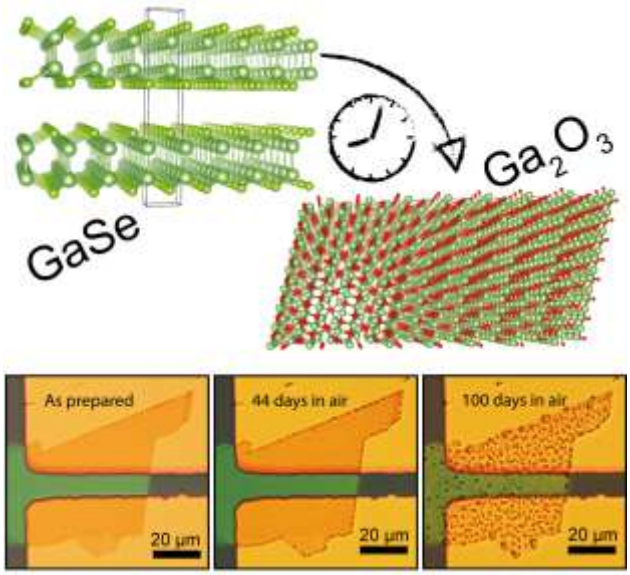

Figure 1: The Schematic of environmental degradation process and the surface morphology evolution of 2D GaSe photodetector in the air.