APRIL 20-21, 2021
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Fundamental Research Insights

GO 2021

Solution-processed photoelectrochemical (PEC)-type photodetectors based on layered GaSe and GeSe nanoflakes

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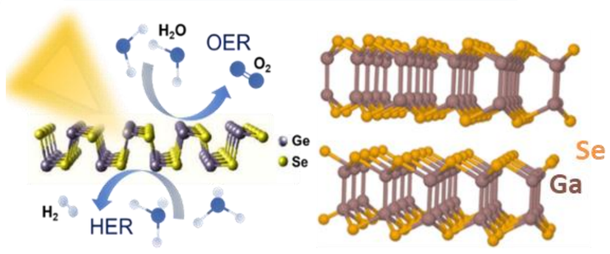
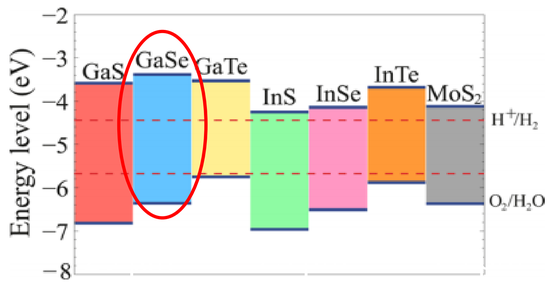
Introduction

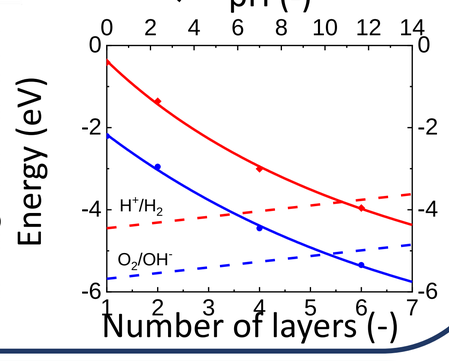
Layered monochalcogenides (MCs) have been predicted as efficient materials for photoelectrochemical (PEC) applications.[1] In this work, **single-/few-/multi-layer flakes of gallium selenide (GaSe) and germanium selenide (GeSe)** have been produced through **liquid-phase exfoliation** of crystals to first develop water splitting system and self-powered **PEC-type photodetectors**. The devices show responsivities up to 0.16 AW^{-1} at -0.5 V *vs.* RHE and 0.32 AW^{-1} at -0.5 V *vs.* RHE under 455 nm excitation wavelength in acidic electrolyte (0.5 M H_2SO_4).[2]

Layered MCs



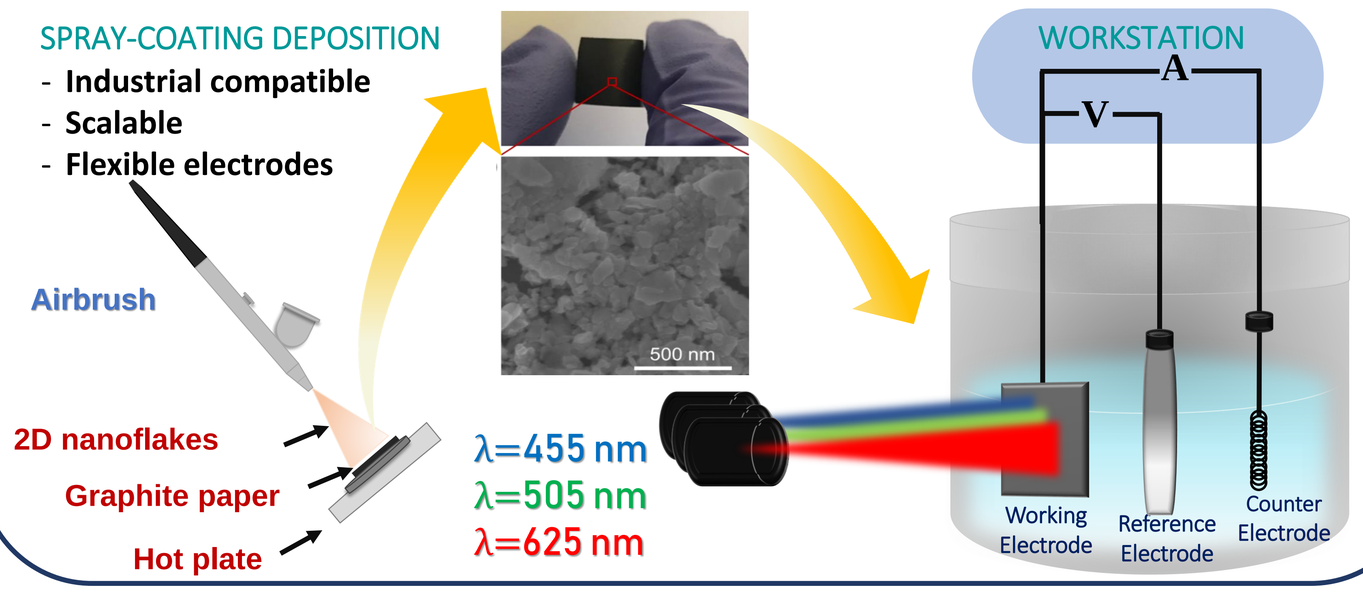


Depending on pH and thickness, MCs nanoflakes can act as photocatalysts for hydrogen and oxygen evolution reaction (**HER**) and **OER**).



Electrodes Fabrication and Experimental Setup

SPRAY-COATING DEPOSITION
- **Industrial compatible**
- **Scalable**
- **Flexible electrodes**

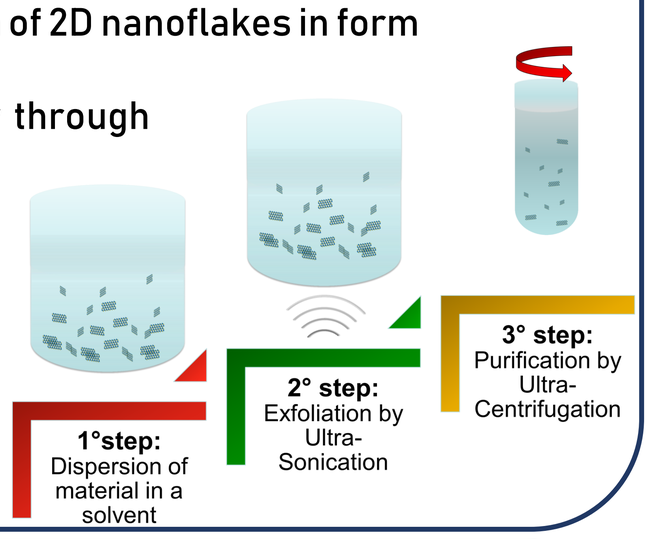


Liquid Phase Exfoliation Process[3]

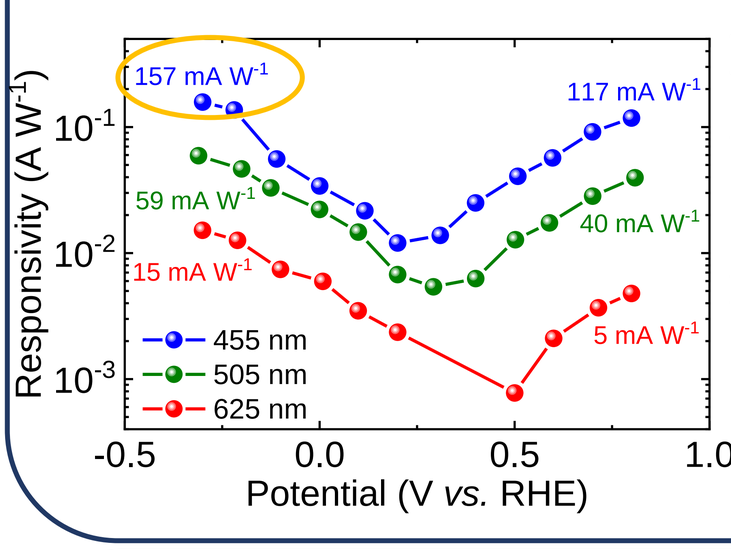
Advantages:
- Scalable production of 2D nanoflakes in form of inks
- High-processability through printing techniques

Equipment:
- Sonic bath
- Centrifuge

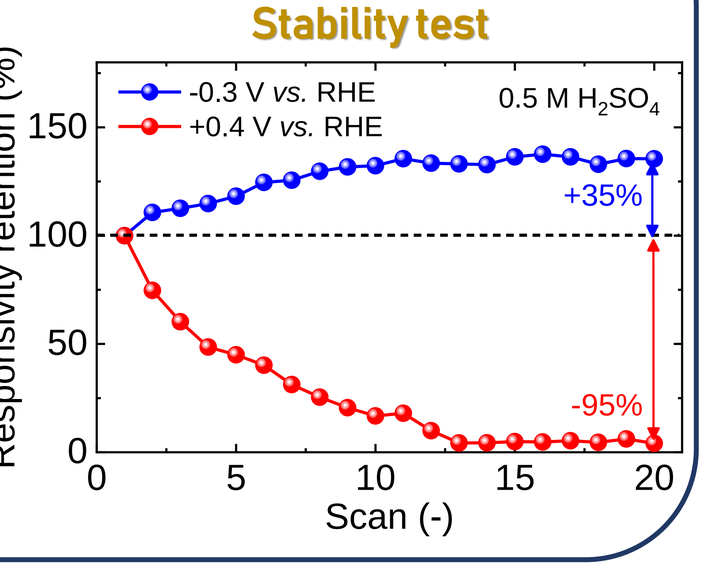
Solvent:
- 2-propanol (IPA)



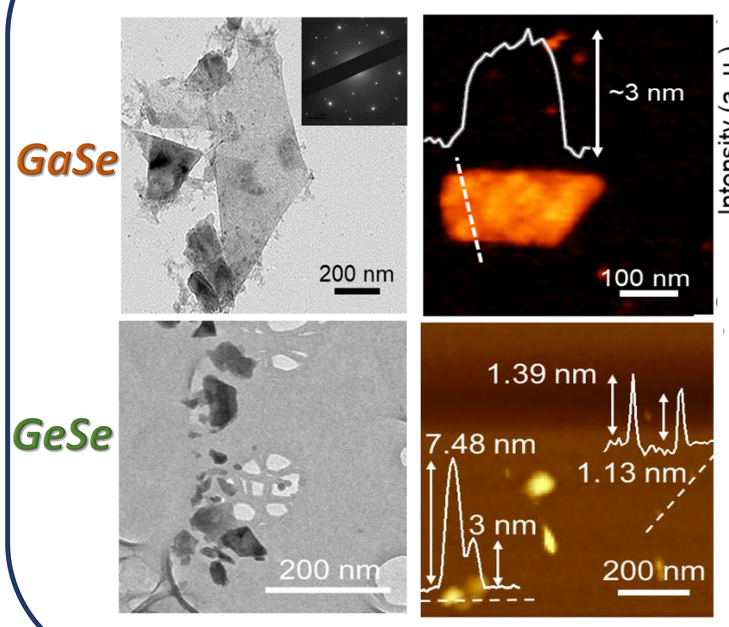
PEC Characterization of GaSe PEC-type Photodetectors

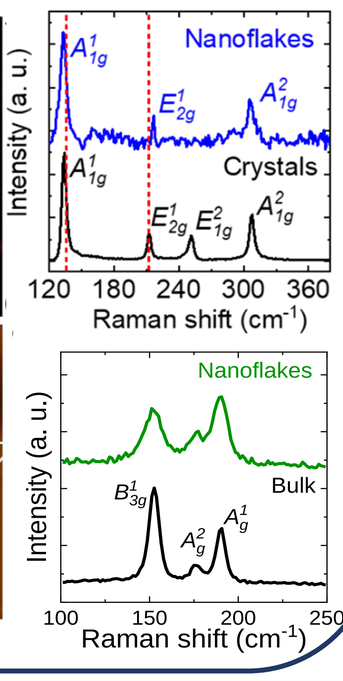


Stability test

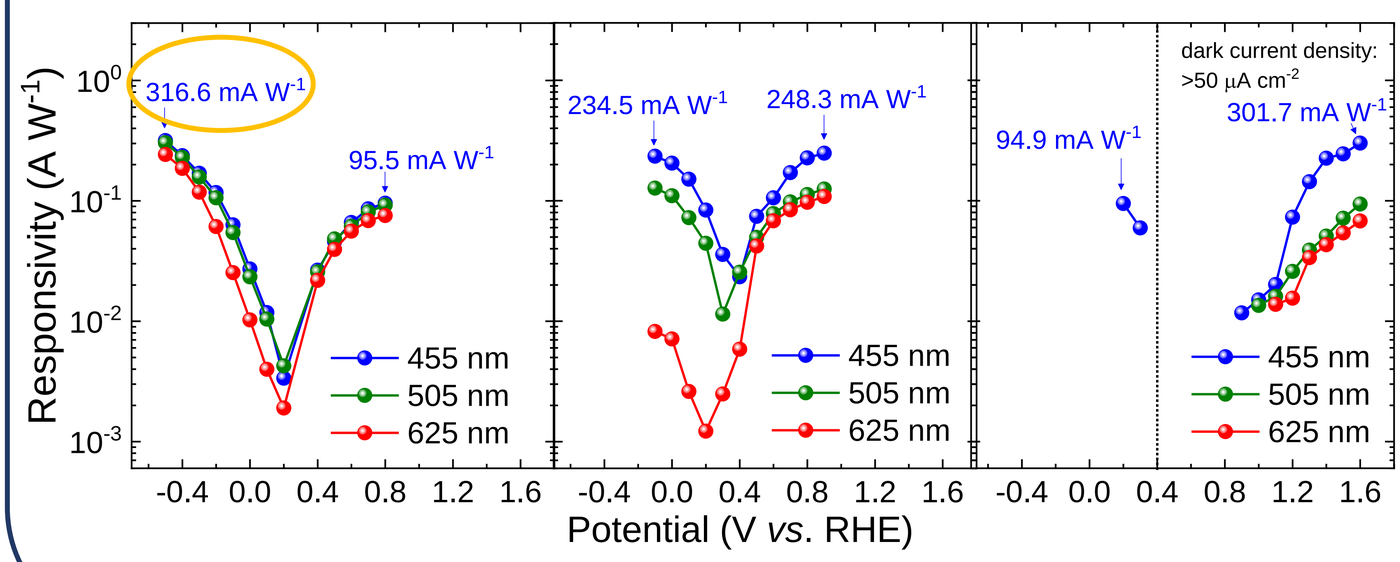


Morphological Characterization





PEC Characterization of GeSe nanoflakes



External Quantum Efficiency (EQE) =86.3%

Conclusion

The obtained performances are superior to those of several self-powered and low-voltage solution-processed photodetectors, approaching the ones of self-powered commercial UV–Vis photodetectors. Our evaluation of the photoelectrochemical (PEC) properties of GaSe and GeSe nanoflakes in aqueous media can open the interest for novel type of water splitting photocatalysts based on group-IVA metal.

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3. F. Bonaccorso et al., Adv. Mater., 2016, 28, 6136

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