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# Liquid-Phase Exfoliated GeSe Nanoflakes For Photoelectrochemical-Type Photodetectors


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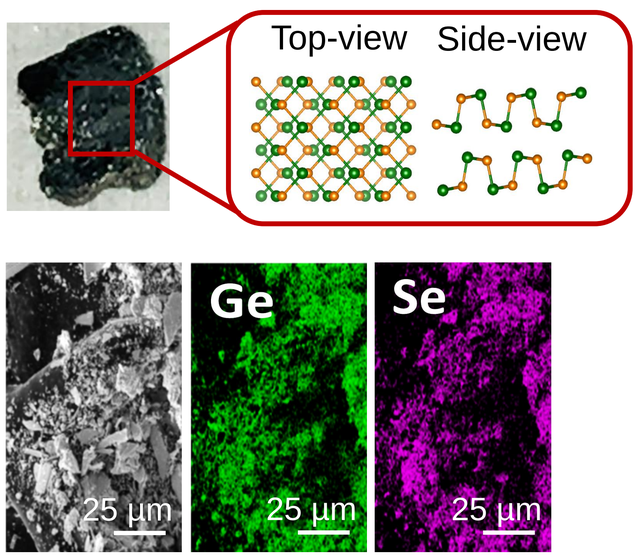
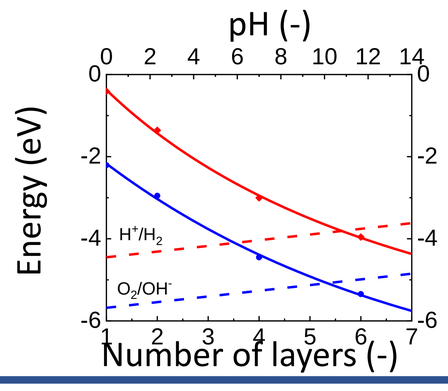
## Introduction

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

## Layered GeSe




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



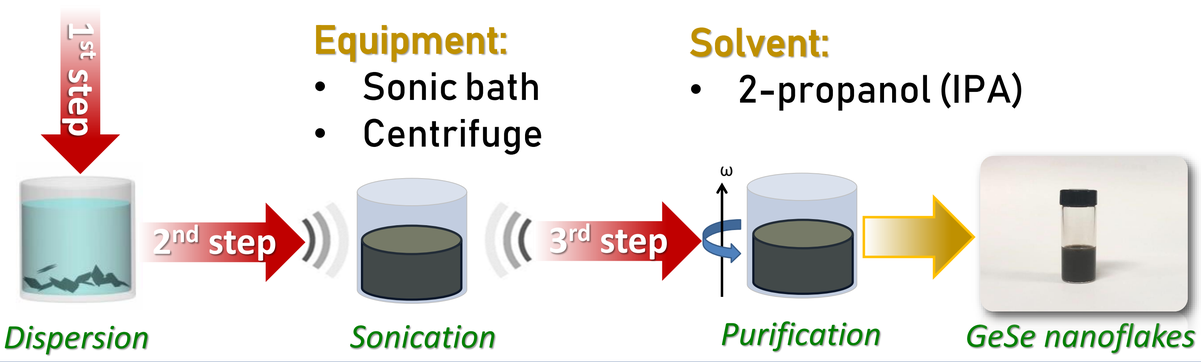

## Liquid Phase Exfoliation Process[2]

*GeSe bulk*

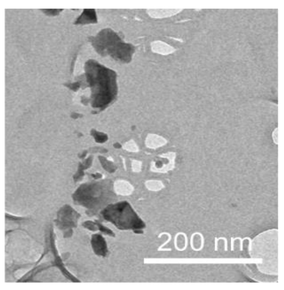
**Advantages:**
- Scalable production of GeSe nanoflakes-based inks
- High-processability through printing techniques

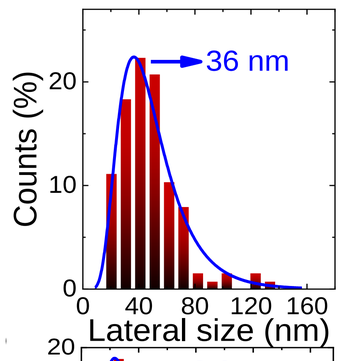
**Equipment:**
- Sonic bath
- Centrifuge

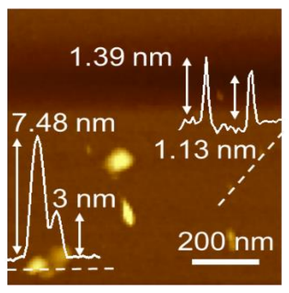
**Solvent:**
- 2-propanol (IPA)

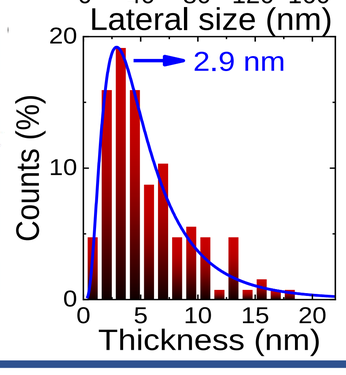


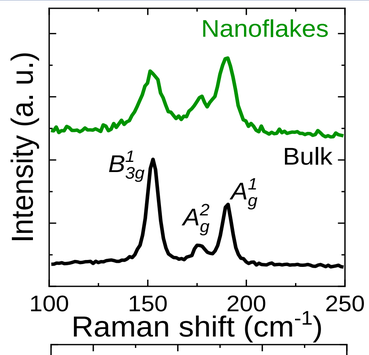

## Morphological Characterization

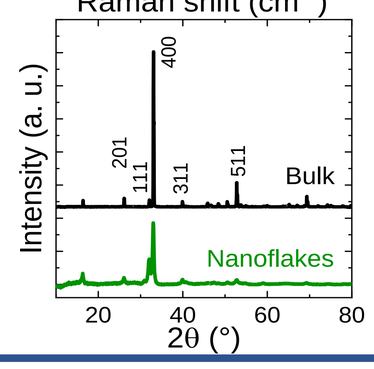


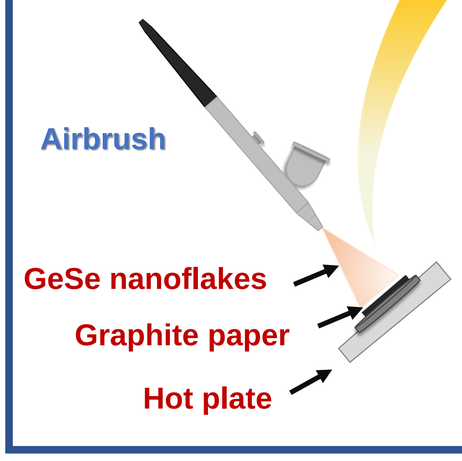



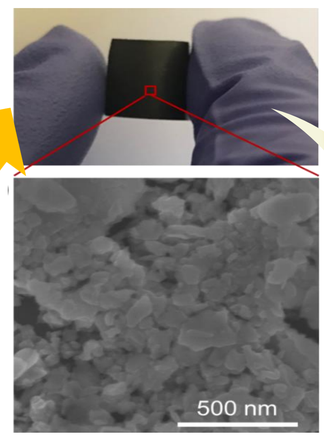



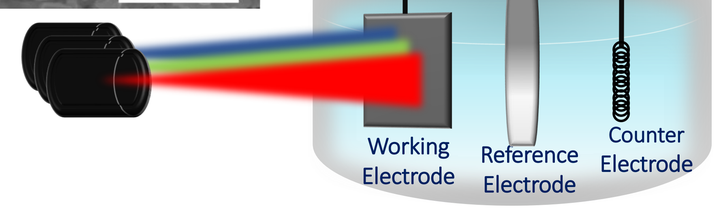




## GeSe-based Electrode Fabrication and Experimental Setup

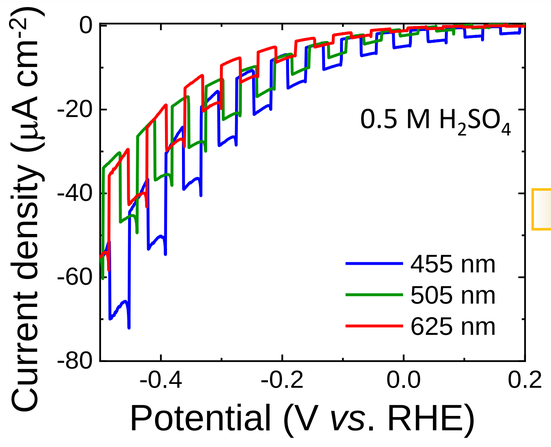
SPRAY-COATING DEPOSITION
- **Industrially compatible**
- **Scalable**
- **Flexible electrodes**

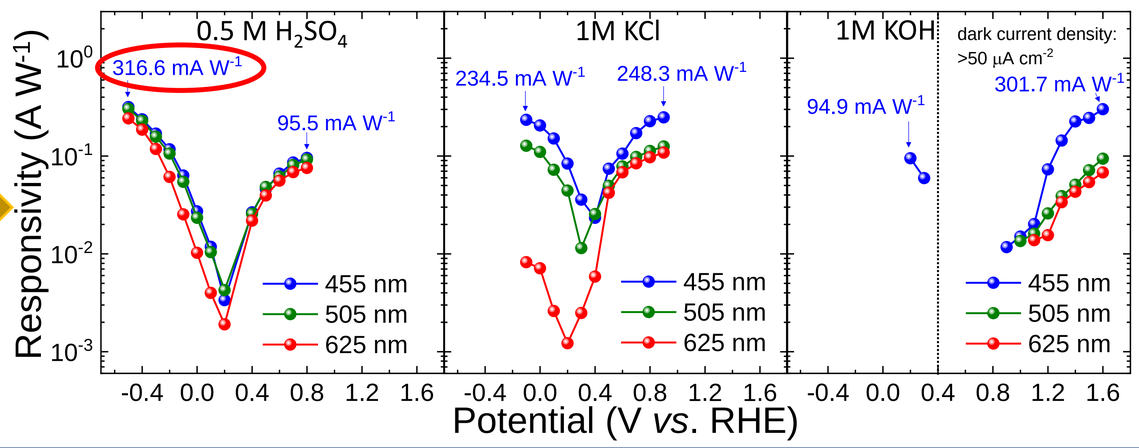


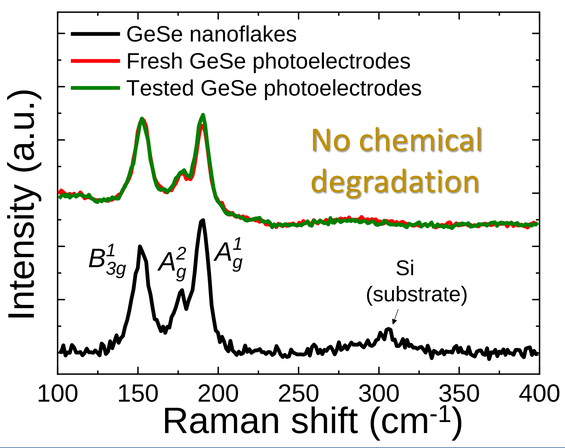




## Photoelectrochemical Characterization of GeSe PEC-type Photodetectors




## 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 results open the way towards the use of 2D GeSe in novel PEC systems.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## REFERENCES


1. M.I. Zappia, G. Bianca et al. Adv. Funct. Mater. 2020, 1909572
2. F. Bonaccorso et al., Adv. Mater., 2016, 28, 6136


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