GRAPHENE AND 2DM VIRTUAL CONFERENCE & EXPO

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Two-dimensional GeSe for Photoelectrochemical (PEC) Applications: Photodetectors and Water Splitting

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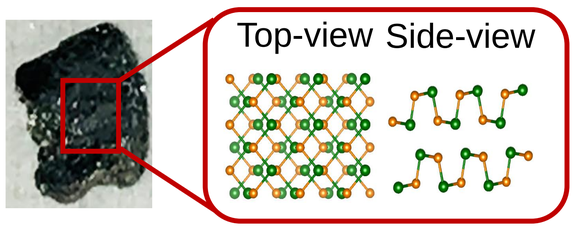
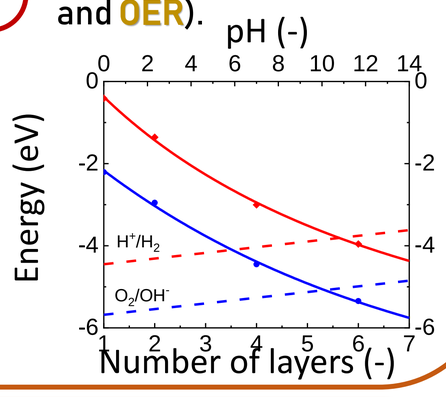
Introduction

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 through **liquid-phase exfoliation** of a GeSe crystals to first 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.[2]

Layered GeSe

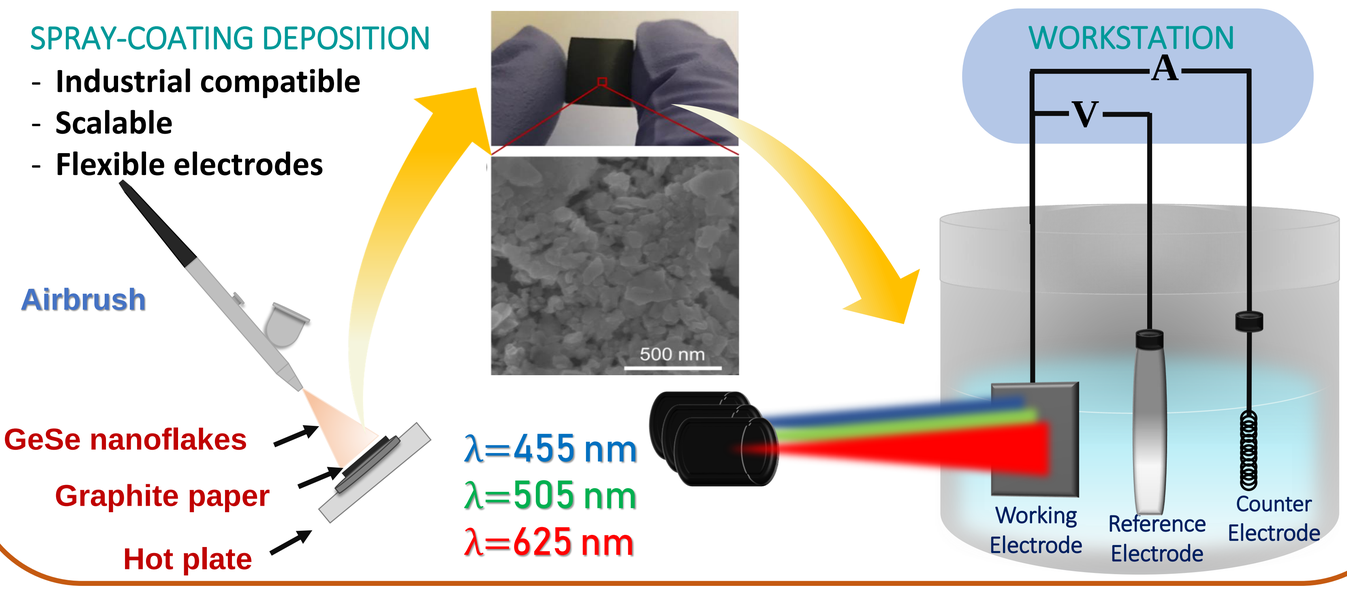


Depending on pH and thickness, GeSe nanoflakes can act as photocatalysts for hydrogen and oxygen evolution reaction (**HER**) and **OER**).



GeSe-based Electrodes Fabrication and Experimental Setup

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

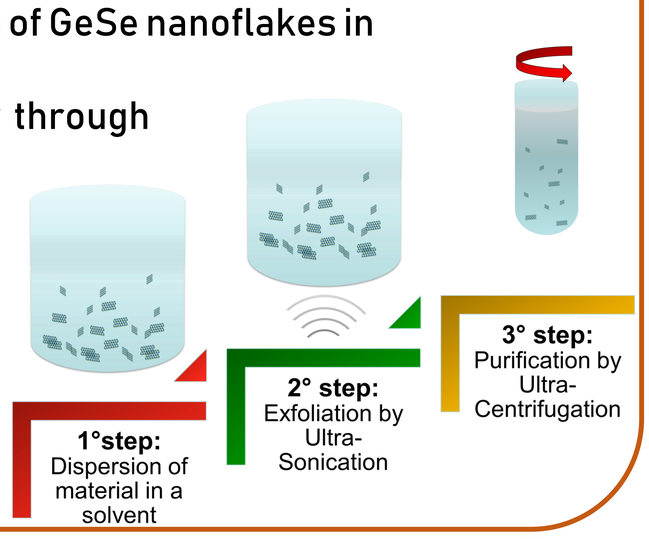


Liquid Phase Exfoliation Process[3]

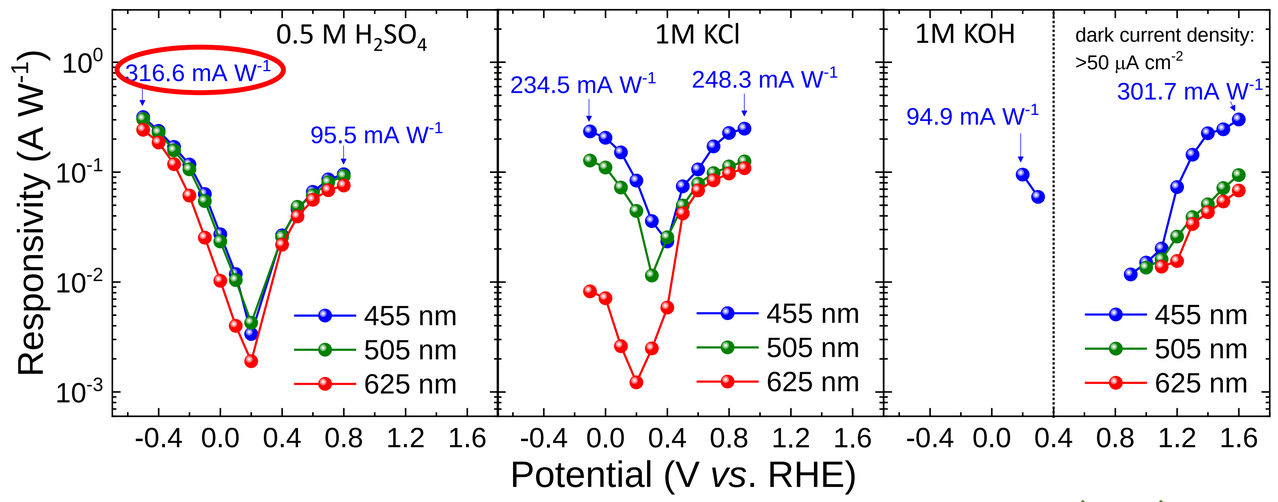
Advantages:
- Scalable production of GeSe nanoflakes in form of inks
- High-processability through printing techniques

Equipment:
- Sonic bath
- Centrifuge

Solvent:
- 2-propanol (IPA)

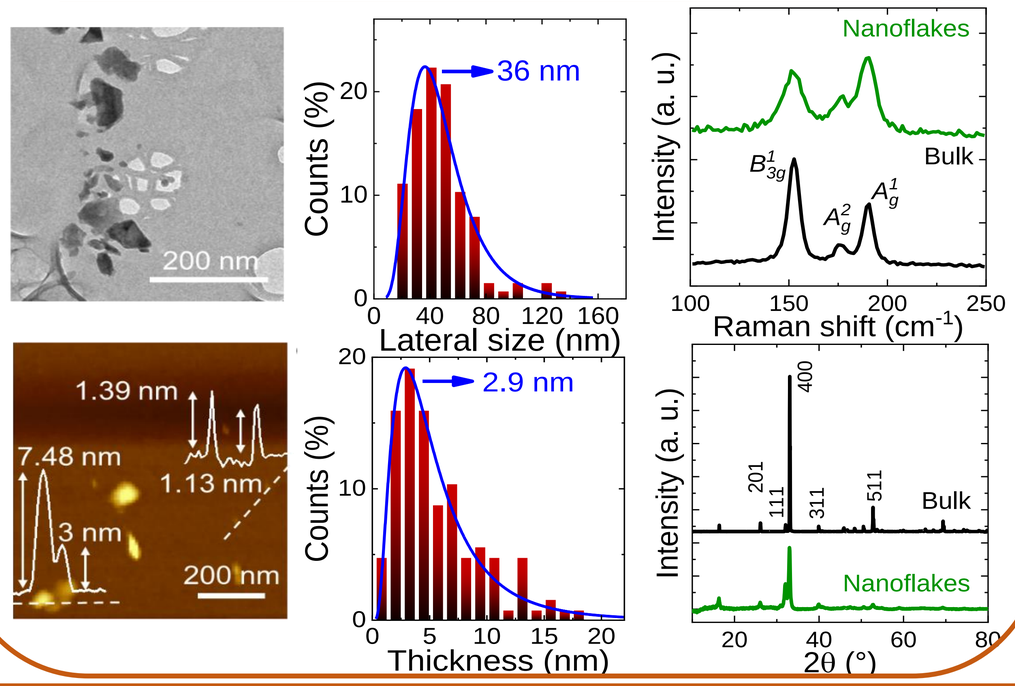


PEC Characterization of GeSe PEC-type Photodetectors



External Quantum Efficiency (EQE) =86.3%

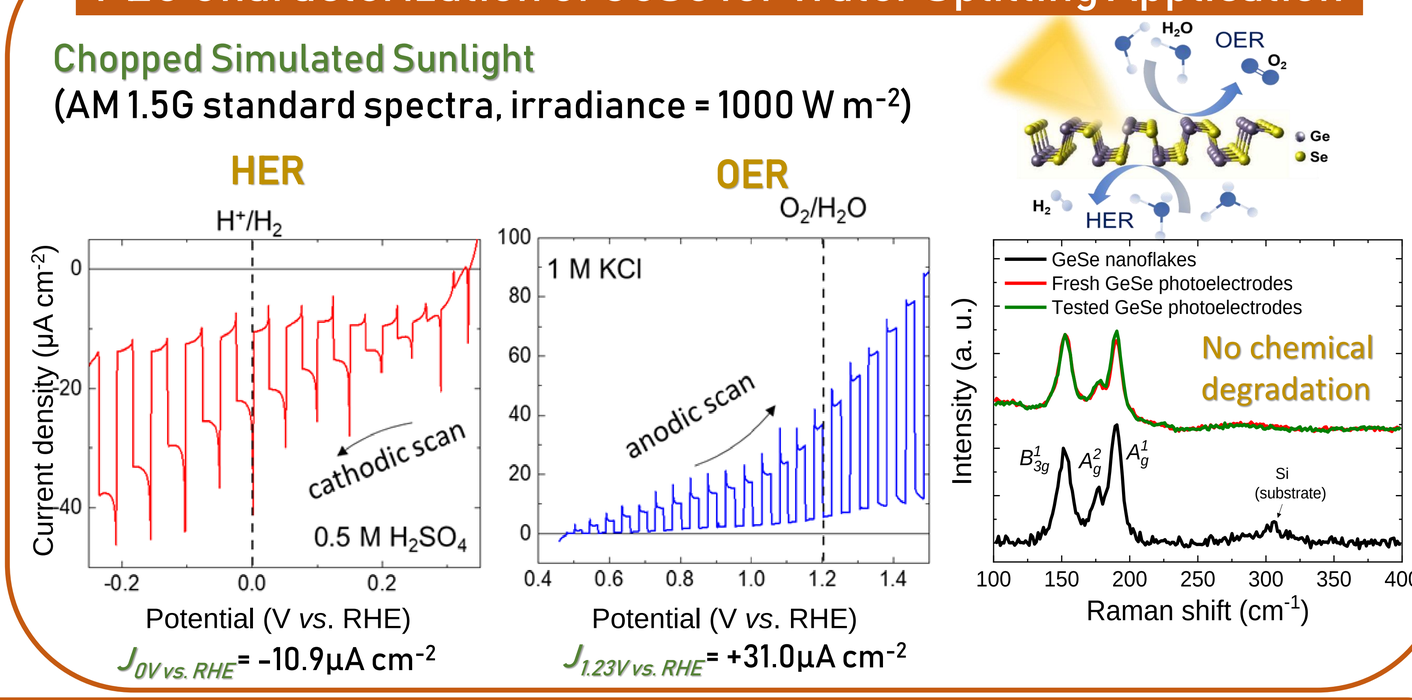
Morphological Characterization



PEC Characterization of GeSe for Water Splitting Application

Chopped Simulated Sunlight

(AM 1.5G standard spectra, irradiance = 1000 W m^{-2})



$J_{0V\ vs.\ RHE}$ = -10.9µA cm^{-2}

$J_{1.23V\ vs.\ RHE}$ = +31.0µA cm^{-2}

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 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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