

Liquid-phase exfoliated GeSe nanoflakes for photoelectrochemical-type photodetectors

Gabriele Bianca^{1,2}

Marilena Isabella Zappia,^{3,4} Sebastiano Bellani,^{1,3} Michele Serri,¹ Leyla Najafi,^{1,3} Beatriz Martín-García,¹ Reinier Oropesa-Nuñez,³ Tomáš Hartman,⁵ David Sedmidubský,⁵ Vittorio Pellegrini,^{1,3} Zdeněk Sofer,⁵ Anna Cupolillo⁴ and Francesco Bonaccorso^{1,3}

¹ Graphene Labs, Istituto Italiano di Tecnologia, via Morego 30, 16163, Genova, Italy

² Dipartimento di Chimica e Chimica Industriale, Università degli Studi di Genova, via Dodecaneso 31, 16146 Genoa, Italy

³ BeDimensional Spa., via Albisola 121, 16163 Genova, Italy

⁴ Department of Physics, University of Calabria, Via P. Bucci cubo 31/C 87036, Rende (CS), Italy

⁵ Department of Inorganic Chemistry, University of Chemistry and Technology Prague, Technická 5, 166 28 Prague 6, Czech Republic

gabriele.bianca@iit.it

ABSTRACT

Photoelectrochemical (PEC) devices represent powerful tools to convert the electromagnetic radiation into chemical fuels and electricity.[1] In particular, PEC cells, including water splitting ones, are emerging for the development of cheap, easily-fabricated, environmentally friendly self-powered photodetectors with high spectral responsivity ($>$ tens of mA W^{-1} for UV-visible spectral region).[2] In this context, two-dimensional (2D) materials are attracting a huge interest as potential advanced photo(electro)catalysts,[3] and, recently, 2D group-IVA metal monochalcogenides have been theoretically predicted to be water splitting photocatalysts.[4] Among them, low-cost and environmentally friendly layered germanium selenide (GeSe), is a promising material candidate for optoelectronic devices due to its properties: tuneable electronic structure, strong visible-light absorbance, photoresponse, photoferroelectricity and environmental stability.[4] Here, we report the first experimental characterization of the photo(electro)catalytic activity of single-/few-layer GeSe flakes in different aqueous media, ranging from acidic to alkaline solutions: 0.5 M H_2SO_4 (pH 0.3), 1 M KCl (pH 6.5), 1 M KOH (pH 14). The PEC properties of the GeSe nanoflakes, produced by liquid-phase exfoliation (LPE) approach[5] in non-toxic solvents (e.g., 2-propanol) and deposited by spray-coating technique,[5] are used to conceive PEC-type photodetectors, reaching responsivity up to 0.32 AW^{-1} under 455 nm excitation wavelength, in acid electrolyte. 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 can open the way towards the use of 2D GeSe in innovative PEC systems.

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FIGURE

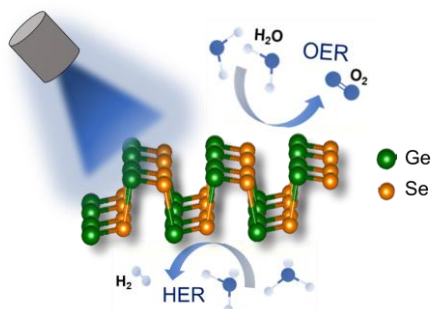


Figure 1: Schematic processes of photoelectrochemical water splitting on GeSe nanoflakes.