

# Configuring Emerging Two-Dimensional Films for Electronic and Optoelectronic Devices

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Isolation of graphene was a milestone in condensed matter physics paving the way to a new and unprecedentedly rich fashion of two-dimensional (2D) materials. While many of them are derived through exfoliation methods, an urgent need remains as to how they can be produced through scalable synthesis schemes and manipulated in diverse functional configurations by design. Here we will report on bottom-up approaches to the synthesis 2D Xenos, their engineering in new materials configuration or hybrids, and their integration into nanotechnology device applications. Xenos, i.e. single-element 2D crystals, are a representative case in this respect [1]. With silicene stannene, and tellurene as examples, we will describe how the Xenos can be synthesized by interface engineering up to developing new Xene hybrids and heterostructures [2]. As results, we will show how to stabilize *silicene membranes* for transfer to a target substrate aiming at electronic device applications like silicene transistors on solid-state platforms and silicene piezoresistors on bendable substrates [3,4]. Alternately, silicene will be reconfigured in a hybrid configuration along with other 2D materials like MoS<sub>2</sub> or a stand-alone flakes aiming at making electronic heterojunctions by design. On the same line, we will also focus on the *tellurium chemistry* to show how to grow 2D materials with unprecedented properties. Tellurium vapours transported by an inert carrier gas in a chemical vapour deposition reactor are exploited to produce topological *ditellurides* by tellurization of a pre-desposited metal film or tellurium nanosheets down to the 2D level (*tellurene*). In the former case, we will report on the growth of PtTe<sub>2</sub> Dirac semimetals aiming at the fabrication of THz plasmonic gratings [5]. In the latter case, tellurium nanosheets on Au-based substrates are designed for diode cells with memristive behavior [6]. The reported cases are examples of how to engineer and configure Xene towards prototypical device structures targeting flexible electronics, nanophotonics, and nanoelectronics.

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