Synthesis and processing of Xenes for functional applications

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As a major breakthrough in condensed matter physics, the isolation of graphene paved the way to the class of monoelemental two-dimensional materials known as Xenes. Currently, this category of materials comprises two generations: the first one includes elements from the IV column of the periodic table, such as silicene, germanene, and stanene, and the second generation is based on elements from adjacent columns, such as borophene, antimonene, tellurene, etc. [1].
Here, we will take as case studies the epitaxy of silicene, stanene, and their heterostructure as well as the synthesis of emerging Xenes like blue-phosphorene, and tellurene [2-3]. We will critically review the key aspects of the Xene synthesis, in terms of scalability and stability, which are fundamental for the exploitation of Xenes in nanotechnology applications. Furthermore, we will summarize the ongoing efforts to develop process schemes for the Xene handling and integration into device platforms [4]. In this respect, we will focus on the recent realization of bendable Xene membranes to prove their versatility in flexible devices, such as strain sensors and piezoresistors. Acknowledgement: funding from H2020 ERC-COG grant n. 772261 “XFab” and ERC-PoC 2022 Grant N. 101069262 “XMem”.

References

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Figures

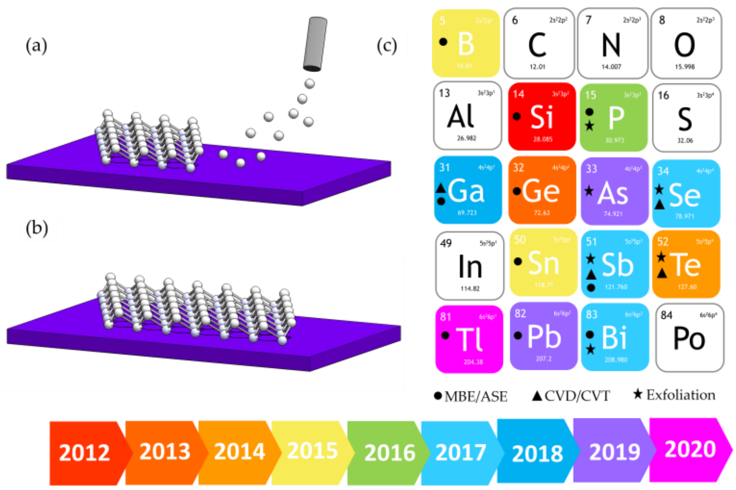

Figure 1: (a)-(b) sketches of the Xene synthesis on a substrate. (c) The periodic table of Xene discovered so far (from 2012 to 2020) and the methods (MBE-CVD-Exfoliation) used for their synthesis. Figure adapted from [1].