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ABSTRACT:

Silicene Applications in Nanotechnology: From Transistors to Bendable Membranes

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Xenes, the monoelemental family of two-dimensional materials, exhibit a variety of interesting properties with potential exploitation in nanotechnology [1]. Silicene, the first Xene ever synthesized, represents an opportunity to face the challenging scaling issues of electronic devices, being compatible with ubiquitous silicon semiconductor technology. In this framework, the configuration where silicene is sandwiched in between an alumina encapsulation layer on the top and thin Ag(111) crystal at the bottom turns out to be a versatile platform for multiple applications. An originally developed integration path for the fabrication of room temperature operating mono and multilayer silicene field-effect transistors will be discussed in light of potential extension to other Xenes [2,3]. Moreover, the encapsulated silicene configuration can also host Xene heterostructures, like silicene-stanene [4], and, most importantly, can be transferred onto a flexible substrate. The application of macroscopic mechanical deformations to the bendable Xenes-based membranes induces a strain-responsive behavior in the Raman spectrum of silicene that shows high-stability up to one thousand bending cycles, thus holding high-potential for flexible electronics [5]. The work is within the ERC-CoG 2017 Grant N. 772261 "XFab" and ERC-PoC 2022 Grant N. 101069262 “XMem”.

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