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ABSTRACT:

Low Dimensional Quantum Topological Group IV Artificial Materials Created by Design

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Silicene, realized in 2012, the silicon-based artificial monoelemental counterpart of graphene, is the first synthetic two-dimensional (2D) Dirac material. Its legacy, called Xenes, are new 2D allotropes of a number of elements from B to Te. From column IV elements, silicene, germanene, stanene, and plumbene have sizeable spin-orbit couplings, allowing for the quantum spin Hall effect, possibly even above room temperature.
Quantum spin Hall insulators generate enormous interest with the prospects of breakthrough applications from Field-Effect Transistors to spintronics and quantum computation.
In my talk I will compare emergent properties and outstanding multifaceted outcomes of
-i- tailored single phase silicene, germanene, stanene and plumbene sheets formed in situ on metallic surfaces under ultra-high vacuum.
-ii- Germanene, seemingly two years younger than silicene and its first successor, which had in reality, its signature encrypted already 51 years ago, but that was deciphered only recently in terms of germanene synthesis through a bottom-up approach,
-iii- Massively parallel 1D penta-silicene nanoribbons grown on Ag(110), with possible applications as 1D helical channels in future devices, and for the emergence and control of Majorana fermions, as well as 0D silicon nanodots, strickly comprising 12 Si atoms.