Chemistry of Xenes – 2D silicon and germanium

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Xenes, a novel class of monoelemental 2D materials comprising silicon, germanium, tin, and other elements, have emerged as a promising frontier in materials science. These materials offer unique opportunities for chemical modifications, enabling precise control over their physical and chemical properties. In recent years, the research activities surrounding other layered materials such as phosphorene, arsenene, silicene, and germanene have grown rapidly, driven by their intriguing properties and potential applications. Monoelements beyond graphene exhibit a distinct advantage as non-zero band-gap semiconductors. This property opens up new horizons for electronic and optoelectronic device applications, where fine-tuning the band gap is essential. Moreover, the properties of 2D materials can be further enhanced and tailored through functionalization, allowing for the realization of novel functionalities and improved performance in various applications.

Despite the significant progress made in the exploration of graphene, the chemistry of materials beyond graphene remains relatively unexplored. This uncharted territory holds tremendous potential for advancements in a multitude of fields, ranging from electronics to energy storage. However, the synthesis of silicene and germanene derivatives presents unique challenges, requiring the application of chemical exfoliation methods using Zintl phase compounds such like CaGe2 and CaSi2 with layered structure as starting materials. To overcome these challenges, various methods well-known in organic chemistry can be applied to synthesize silicene/germanene derivatives, enabling almost complete derivatization of the 2D material skeleton.

This work was supported by ERC-CZ program (project LL2101) from Ministry of Education Youth and Sports (MEYS).