

**Soft chemical synthesis of 2D-nanomaterials:
Silicon sheet and black phosphorus**

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Abstract:

Two-dimensional nanomaterials are expected to show different properties from those of bulk materials due to the surface functionalization and quantum size effects. Since facile fabrication processes of large area nanosheets are required for practical applications, a development of soft chemical synthesis route without using conventional vacuum processes is a challenging issue. Techniques for the exfoliation of layered compounds are widely used to fabricate nanometer-thick materials, such as oxides, niobates, chalcogenides, phosphates, and graphene. Although a variety of nanosheets have been synthesized, there have been few reports of silicon and phosphor nanosheets. Mass production of silicon and phosphor nanosheets without conventional vacuum processes and vapor deposition can be achieved using low cost top-down approach starting from materials that comprise a 2D sheet structure as a fundamental unit. Chemical processes provide an alternative route to large-scale synthesis of 2D nanomaterials under production conditions.

Silicon Nano-sheets (SiNSs), low dimensional crystalline silicon materials with their high specific surface area, makes them promising candidates for a variety of applications in nanoscience and nanotechnology. There are two prominent types of SiNSs:

- buckled sheet mainly based on the Si (111) structure, with the same honeycomb lattice structure, but is corrugated due to sp³ hybridization.
- silicene with a graphene-like honeycomb lattice structure and a mixed sp³-sp² hybridization, that is weakly corrugated.

On the other hand, black phosphorus (BP) was more recently introduced as a new member of the 2D layered material family; it is the most stable allotrope amongst the group also including white, red and violet phosphorus. Black phosphorus, with a graphite-like layered structure, can be effectively exfoliated up to the single atomic layer called phosphorene.

In this perspective, this work focuses on recent progress in soft chemical fabrication of 2D-nanomaterials:

- ✓ silicon nanosheets and their chemical modification,
- ✓ black phosphorus (BP) and its exfoliation to phosphorene.

Contribution:

Invited ☒