Single crystalline 2D and 3D nanomembranes for materials innovation from energy storage to AI hardware

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Abstract (Century Gothic 11)

Thin film technology involves the deposition of thin layers of material, typically ranging from a few nanometers to several micrometers thick, onto a substrate. These films consist of diverse materials such as metals, semiconductors, ceramics, and polymers, playing pivotal roles across electronics, optics, energy, and sensing applications. While Silicon has traditionally dominated thin-film innovation due to its mature processing, the demand for higher performance and novel functionalities has spurred the exploration of new materials. Emerging freestanding nanomembranes, including 2D materials and ultrathin 3D nanomembranes, represent a promising avenue for material innovation, offering unique properties and enabling the development of novel devices and the discovery of new physical phenomena.

Our team has been at the forefront of material innovation, focusing on the development of freestanding 2D and 3D nanomembranes. We have devised novel methodologies to create these materials, which possess characteristics such as extreme thinness, low stiffness, and low internal stress. These features facilitate easy vertical stacking and 3D integration, making them ideal platforms for exploring new physical phenomena and realizing innovative device architectures through the formation of artificial heterostructures. In this presentation, I will discuss the general principles underlying the production of such nanomembranes and their energy applications.

References

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Figures

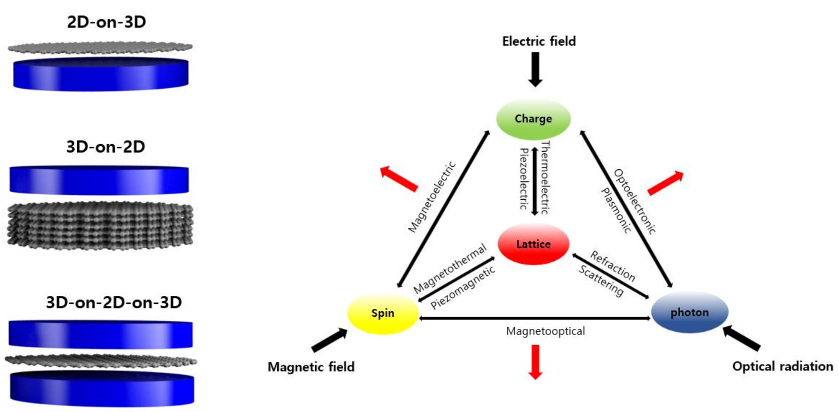

Figure 1: Artificial Heterostructures and various physical coupling