## A Decade of Penta-Graphene: From Theorical Prediction to Novel Pentagonal Materials

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Pentagons, as distinctive geometric structural units, have revolutionized advanced material design. Since our initial discovery of penta-graphene in 2015,<sup>1</sup> the landscape of pentagonal materials has expanded significantly over the past decade in several key aspects: (1) Chemical compositions have progressed from unitary to binary, ternary, and multielement systems, leading to the experimental synthesis of penta-Si, penta-PdSe<sub>2</sub>, penta-NiN<sub>2</sub>, penta-PdTe<sub>2</sub>, and penta-PdPSe; (2) Structural units have evolved beyond individual atoms to include molecules and clusters; (3) Dimensionality has extended from 2D to 3D architectures; (4) Properties now encompass not only electronic characteristics but also higher-order phonon scattering and coherence, facilitating the exploration of ultralow thermal conductivity; (5) Applications have expanded beyond field-effect transistors to include batteries, photodetectors, gas sensors, thermoelectrics, and ferroelectrics. In this talk, we provide a brief review of recent advancements in this field,<sup>2,3</sup> and report our recent findings on sliding ferroelectricity in pentagonal bilayers<sup>4</sup> and trilayers.<sup>5</sup>

## References

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