Double Ionic Gated 2D Crystals

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One of the most thrilling advancements in condensed-matter physics and materials science in recent years is arguably the emergence of two-dimensional (2D) moiré materials (**Figure 1) [1]**. They offer numerous advantages over their bulk counterparts due to their in situ tunability—unlike bulk crystals with fixed charge densities, 2D moiré materials allow for continuous adjustment of charge density across a wide range through electrostatic gating [2,3]. However, the fabrication of 2D moiré devices is challenging—not only due to the delicate nature of the materials, but also because integrating an electrostatic gate, especially a liquid gate, can lead to a short operational lifespan, often caused by leakage issues [4]. Therefore, to fully realize the promise of moiré materials, device fabrication processes should be optimized. Here, we report a simple step-by-step method for fabricating double-gated twisted graphene devices, which enables the study of interlayer twisting and the decoupling of the interfacial electric field from charge carrier density due to the double-gated configuration.

References

[1] Cao Y, Fatemi V, Fang S, Watanabe K, Taniguchi T, Kaxiras E, Jarillo-Herrero P, Nature, 556 (2018) 43-50.
[2] Chun Ning Lau, Marc W. Bockrath, Kin Fai Mak & Fan Zhang, Nat. Rev., 602 (2022) 41-50.
[3] Yu Y, Zhang K, Parks H, Babar M, Carr S, Craig IM, Van Winkle M, Lyssenko A, Taniguchi T, Watanabe K, Viswanathan V, Nat. Chem., 14 (2022) 267-273.
[4] Tong J, Fu Y, Domaretskiy D, Della Pia F, Dagar P, Powell L, Bahamon D, Huang S, Xin B, Costa Filho RN, Vega LF, Nature, 630 (2024) 619-624.

Figures

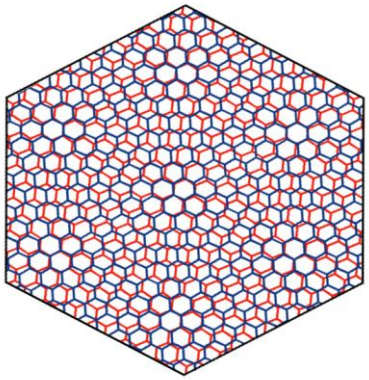

Figure 1: Ideal moiré superlattice [2].

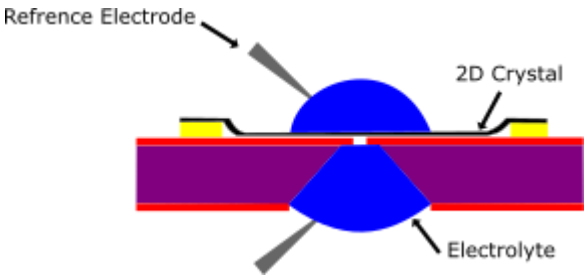

Figure 2: Double gated configuration.