Controlled synthesis of wafer-scale single-crystal metal thin films for epitaxial graphene growth

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Single-crystal Cu(111) thin films, owing to their excellent catalytic properties and atomic flatness, are widely regarded as ideal substrates for the epitaxial growth of single-crystalline two-dimensional (2D) materials such as graphene and hBN. Alloying strategies to fabricate Cu-based single-crystal alloy films can further expand the substrate platform for 2D material growth, while enabling precise control over their structure and properties. In this work, using single-crystal sapphire wafers as epitaxial substrates, we developed a series of controlled fabrication methods and alloying techniques to prepare 4~8 inch, ultraflat, twin-boundary-free Cu(111) single-crystal metal thin films and alloy thin films. Utilizing these substrates together with our custom-designed pilot-scale growing systems, we achieved chemical vapor deposition (CVD) synthesis and batch production of single-crystal graphene wafers with high electrical quality and uniformity.

References

[1] Zhu, Y., Zhang, J., Cheng, T. Adv. Mater., 36(2024) 2308802.

Figures

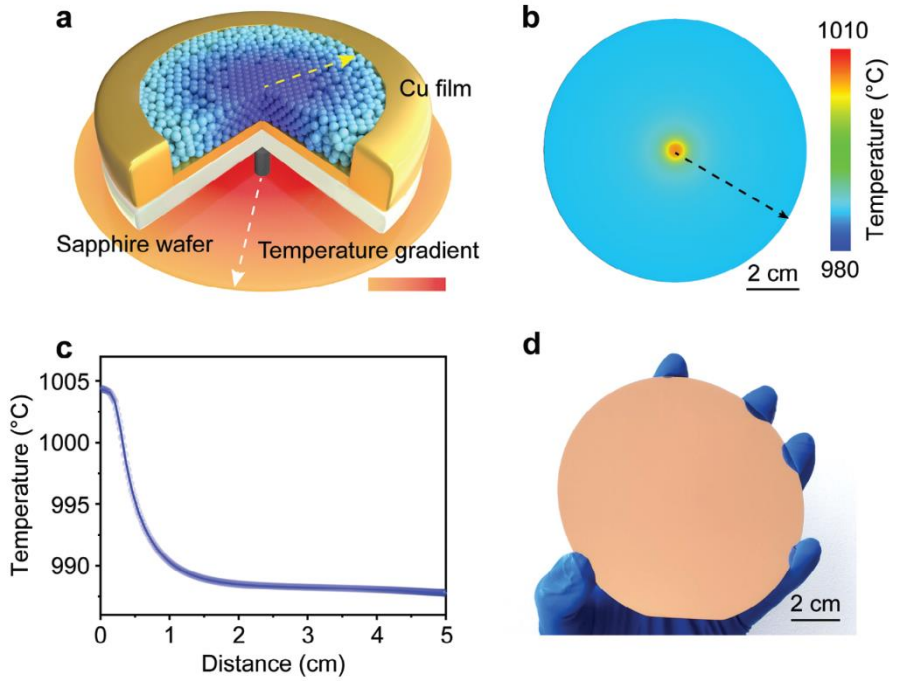

Figure 1: Schematic illustration for the fabrication of single-crystal Cu(111) thin films on sapphire.