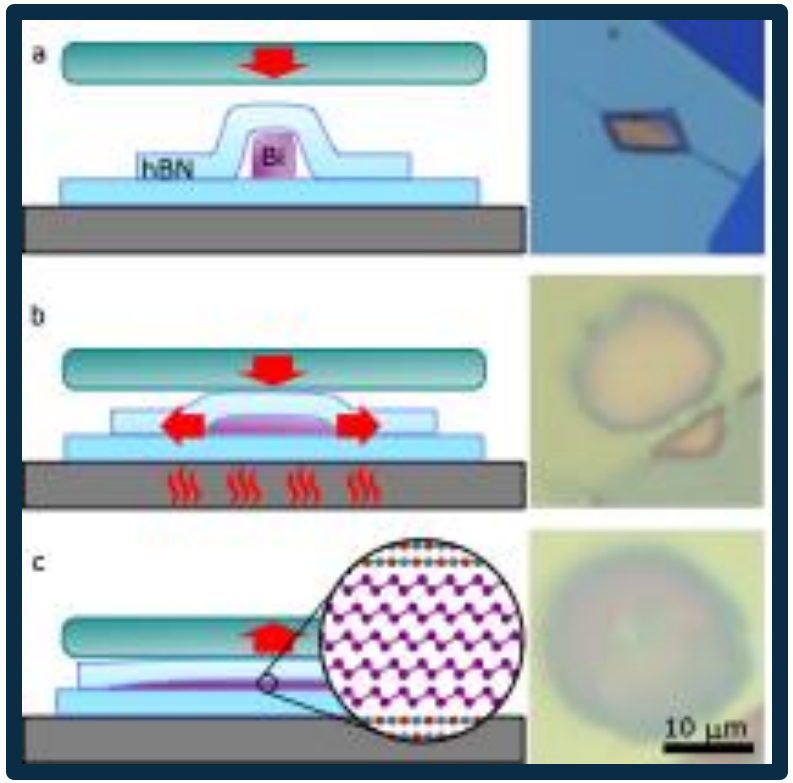
Van der Waals Molding Offers a New Route to 2D Bismuthene



Growth of ultrathin bismuth crystals inside a vdW-mold. Cross-sectional schematics of the vdW-mold process with corresponding optical images of the bismuth.

Chen, L.; Wu, A. X.; Tulu, N.; Wang, J.; Juanson, A.; Watanabe, K.; Taniguchi, T.; Pettes, M. T.; Campbell, M. A.; Xu, M.; Gadre, C. A.; Zhou, Y.; Chen, H.; Cao, P.; Jauregui, L. A.; Wu, R.; Pan, X.; Sanchez-Yamagishi, J. D. "Exceptional electronic transport and quantum oscillations in thin bismuth crystals grown inside van der Waals materials," *Nature Materials*, (2024).

Scientific Achievement

New 2D bismuth work led by CINT Users Javier Sanchez-Yamagichi and Luis Jauregui demonstrates that the atomically smooth nature of van der Waals materials such as hexagonal boron nitride make them ideal nanoscale molds for confined crystal growth, shown here to obtain 2D bismuth.

Significance and Impact

Ultrathin and flat crystals of bismuth have now been grown between the atomically-flat layers of a van der Waals material. The vdW-molded bismuth exhibits exceptional electronic properties, including gate-tunable quantum oscillations of the magnetoresistance.

Research Details

- The vdW-molded bismuth showed clear signs of quantum confinement and exhibited electronic transport properties that were an order of magnitude better than material grown by molecular beam epitaxy.
- The team observed that the topological bismuth surface states dominated the conductivity with a strongly metallic dependence from 1 Kelvin up to 290 Kelvin.