Growth of hexagonal BN crystals by traveling-solvent floating zone

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Sophisticated electronic devices based on ultra-thin materials—two-dimensional materials that are as thin as a single atom—require bespoke materials to serve as substrate, insulator, or encapsulation. It has long been known that hexagonal boron nitride (h-BN) offers many of the sought-after properties. Recently, h-BN garnered interest in its own right, for applications in photonics, non-linear optics, quantum information science, and sensing technologies. Many of the advances were enabled by progress in the synthesis of large, high-purity single-crystals of hexagonal BN (h-BN) that are commonly made at high temperatures and GPa pressures.

Users of PARADIM set out to address several challenges associated with h-BN single crystal growth, namely increasing sample volume while maintaining high purity and crystallographic perfection. Starting from novel fluxes pioneered by the users, and applying the LPG and TSFZ methods, the team shows the successful growth of multi-mm scale h-BN crystals with excellent crystalline quality.

This work lays the foundation for new generations of scalable electronic devices that rely on h-BN.

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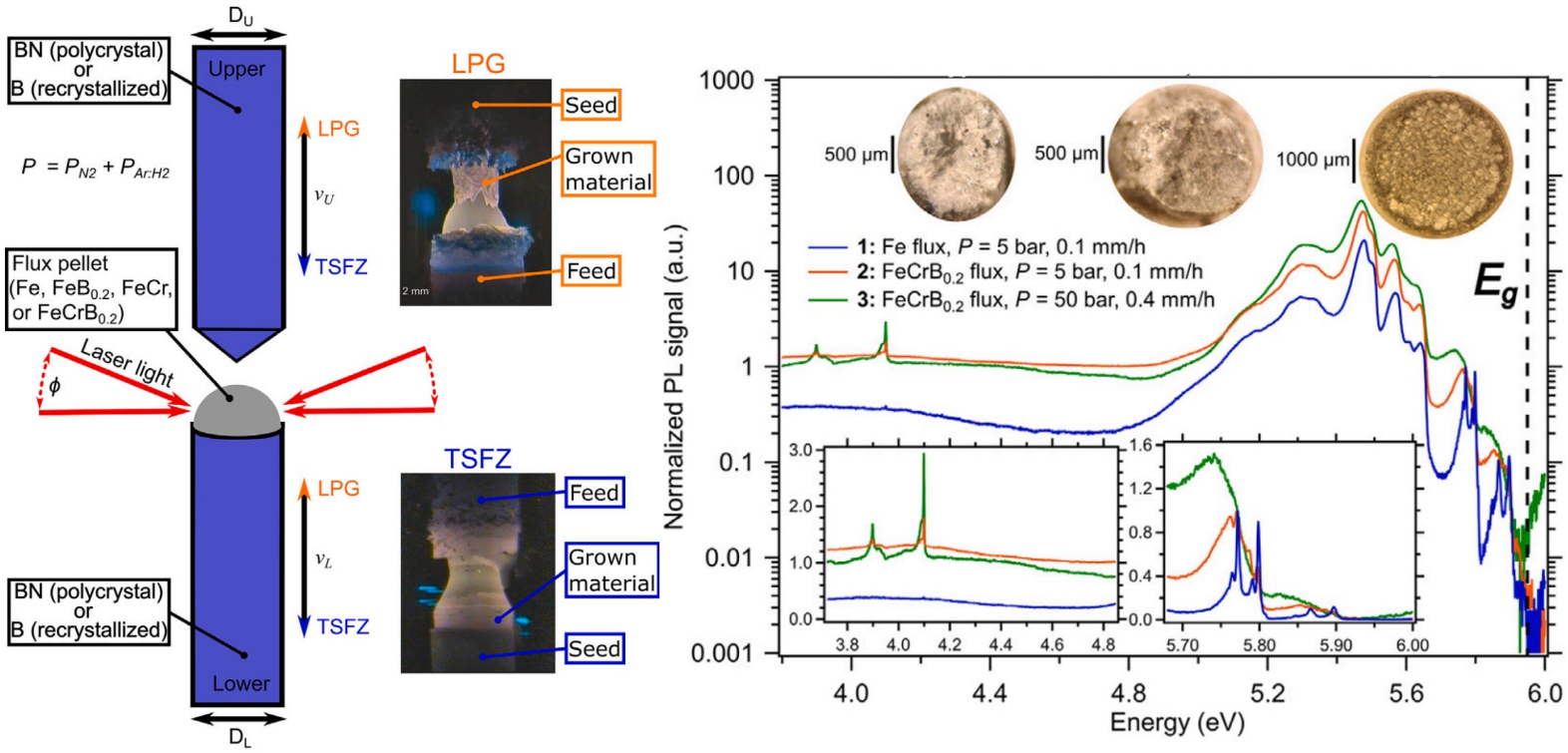

(left) Solvent Laser Pedestal (LPG) and Traveling Solvent Floating Zone (TSFZ) of h-BN combines an intermetallic flux with a boron or boron nitride feed and nitrogen gas to enable controlled crystallization of h-BN without requiring extreme pressure. **(right)** optimized samples (blue) produced in this fashion have no observable in-plane defect photoluminescence at 3.9/4.1 eV. Well-resolved photon sub-bands at 5.8 eV, indicating quality at least as good as previous state of the art produced by high pressure methods, and now in larger crystal boule sizes than was previously possible. (Patent Pending)