MIP: PARADIM at Cornell University, DMR-1539918

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# Growth of Stoichiometric $B_4C$ Single Crystal by Laser Floating-Zone Method

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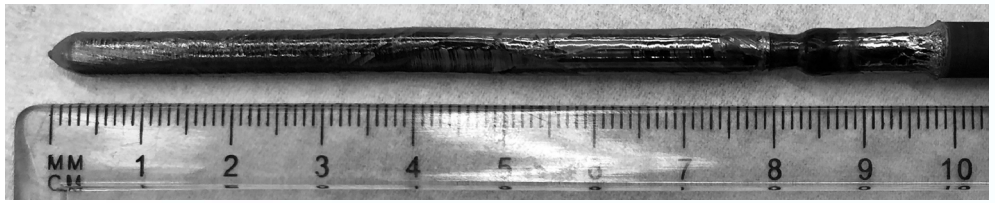
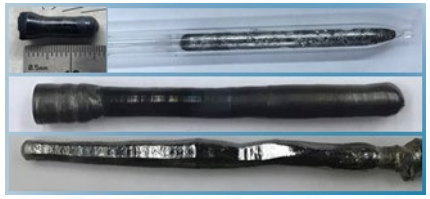
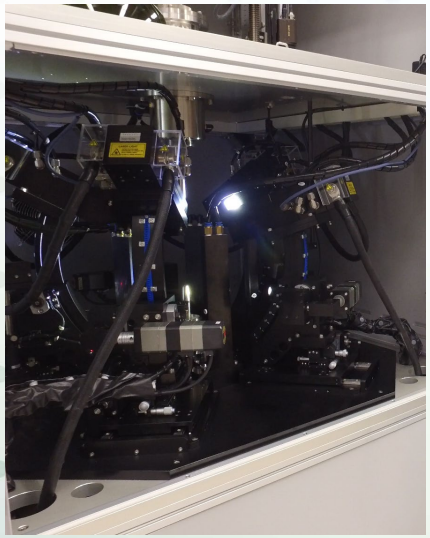
Boron carbide ($B_4C$) is an extremely hard material, with a melting temperature above 2000°C; its electronic properties vary strongly with the precise composition.

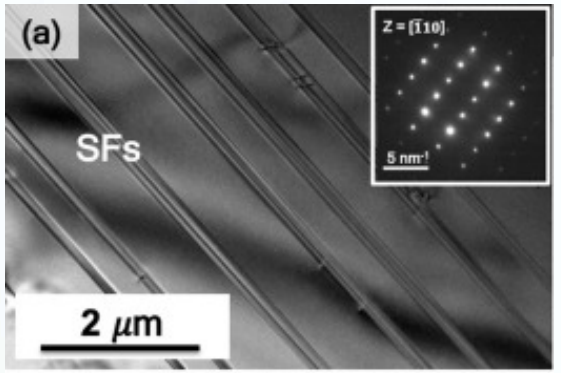
PARADIM's tilting laser diode floating zone furnace enables users to routinely grow $B_4C$ single crystals for further study. The *in-situ* monitoring of gas-phase species during the growth provides insights on the underlying mechanism by which the composition changes and enables the successful growth of single crystals with controlled stoichiometry. Various growth rates were explored to mitigate microstructure defects (including stacking faults, SF) and zone refinement allowed for a significant reduction of trace impurities.

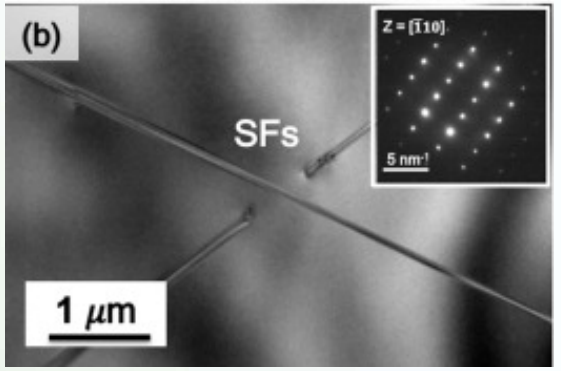
Initial analysis by powder x-ray diffraction confirms that the crystals are indeed rhombohedral $B_4C$, with a hardness of 41±1 GPa and a Young's modulus of 520±14 GPa revealed by nano-indentation. Laser light was found to induce graphitization in the presence of air, enabling a new process to fabricate electronic structures in boron carbide with micron or nanoscale precision.








M. Straker *et al.* *J. Cryst. Growth* **543** (2020) 125700.
M. Chandrashekhar, US20190352234-A1 (2019).

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