

Supplementary Materials for

Tuning the deformation mechanisms of boron carbide via silicon doping

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Supplementary Materials

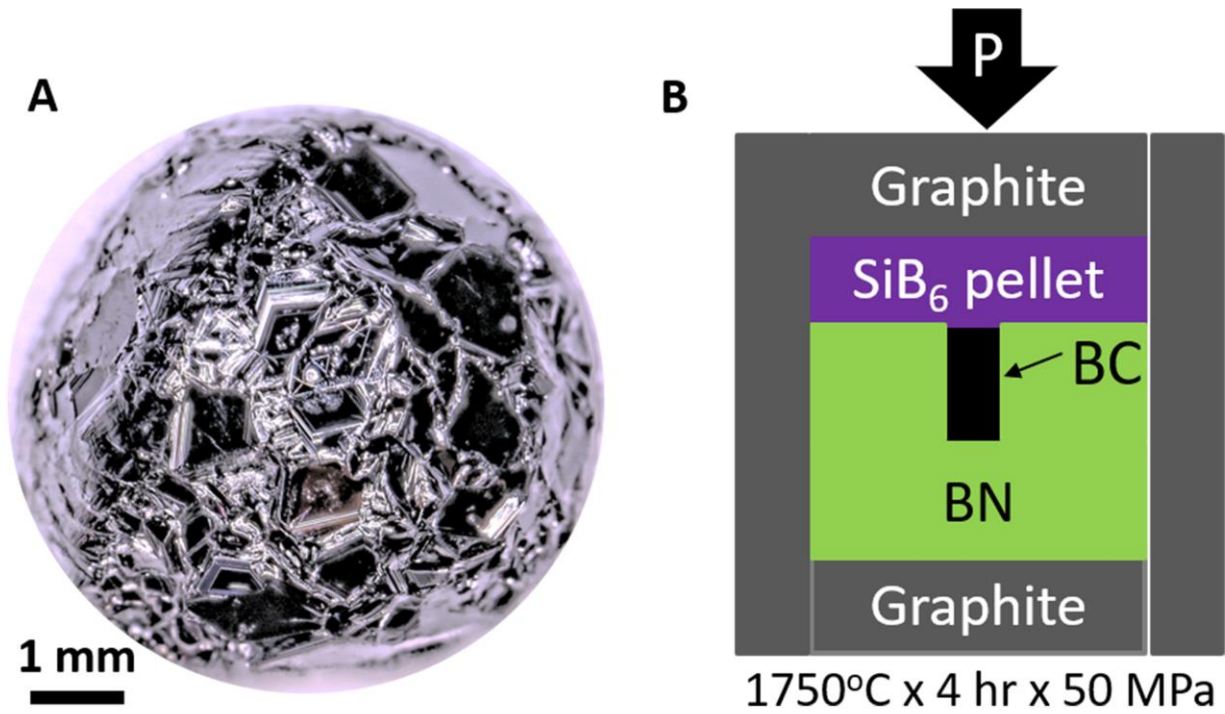


Fig. S1. Preparation of the diffusion couple. (A) Optical image (top view) of the as-melted boron carbide. Millimeter-sized crystals are visible on the top surface of the ingot. (B) Schematic of the die set up used to diffuse Si into boron carbide.

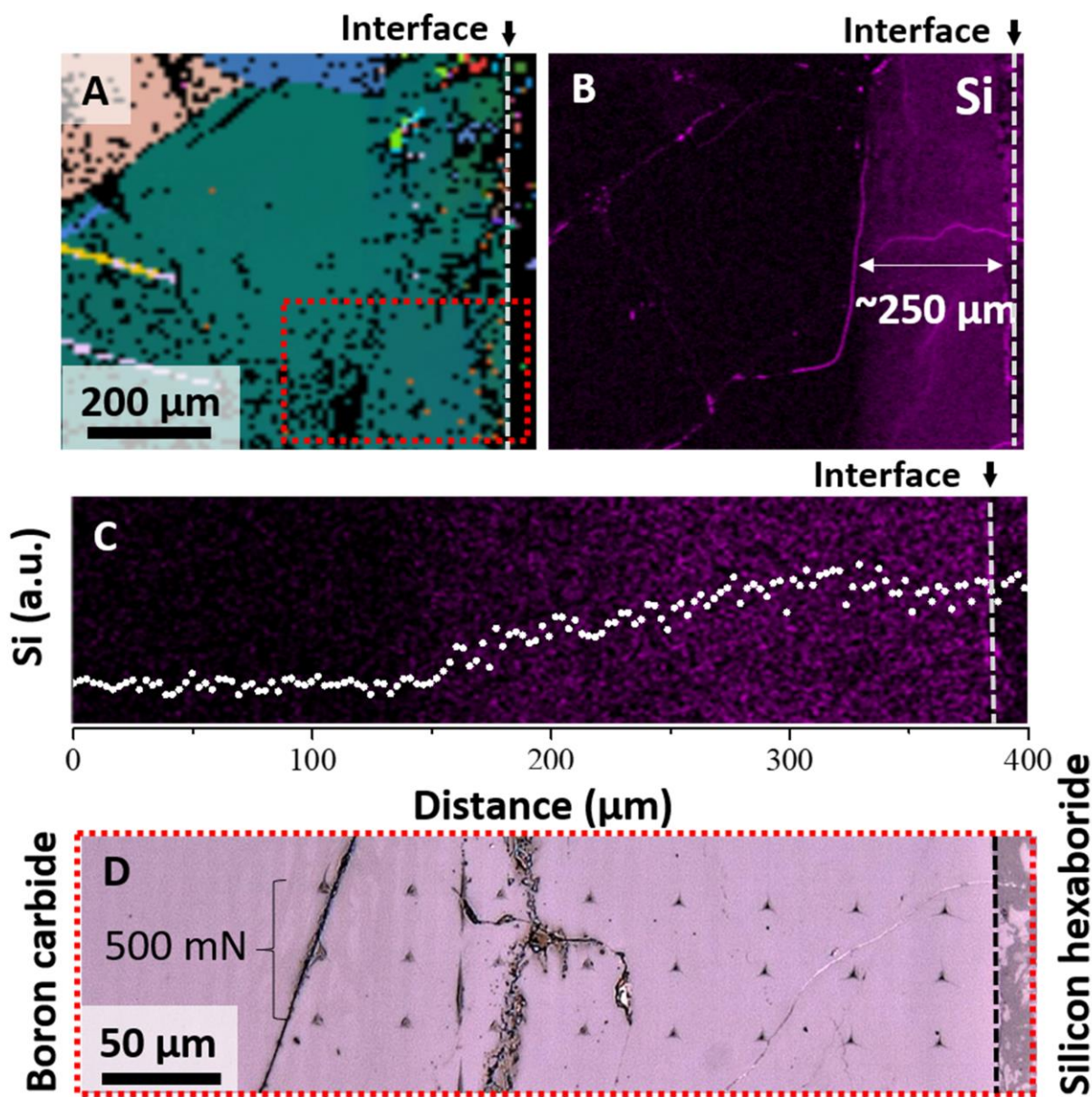


Fig. S2. Berkovich nanoindentation was performed across the Si diffusion zone and the undoped boron carbide within one boron carbide grain. (A) EBSD mapping of the interface showing the same crystal orientation, suggesting a single crystal grain. **(B)** Si EDS mapping of the corresponding location clearly shows that Si diffused roughly 250 μm into boron carbide. **(C)** EDS mapping on the diffusion zone and superimposed normalized Si count. **(D)** Optical image of the indented area showing 3 rows of 8 500 mN Berkovich indents across the diffusion zone. The dashed lines indicate the diffusion interfaces.

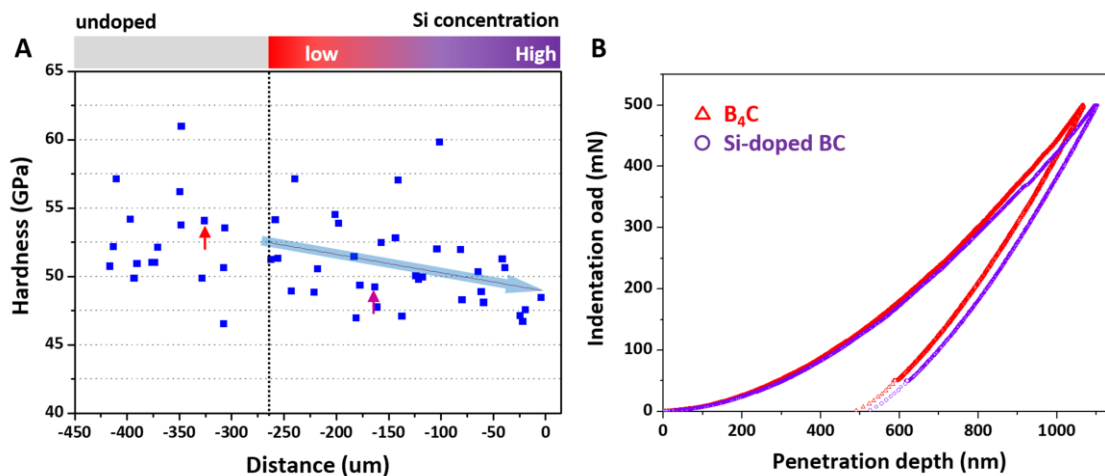


Fig. S3. Berkovich nanoindentation results for undoped and Si-doped boron carbides. (A) Berkovich hardness across the diffusion zone in boron carbide -SiB₆ couple. Zero on the x-axis indicates where the interface of SiB₆ and Si-doped BC is. (B) Typical nanoindentation load-displacement curves for undoped and Si-doped boron carbides.

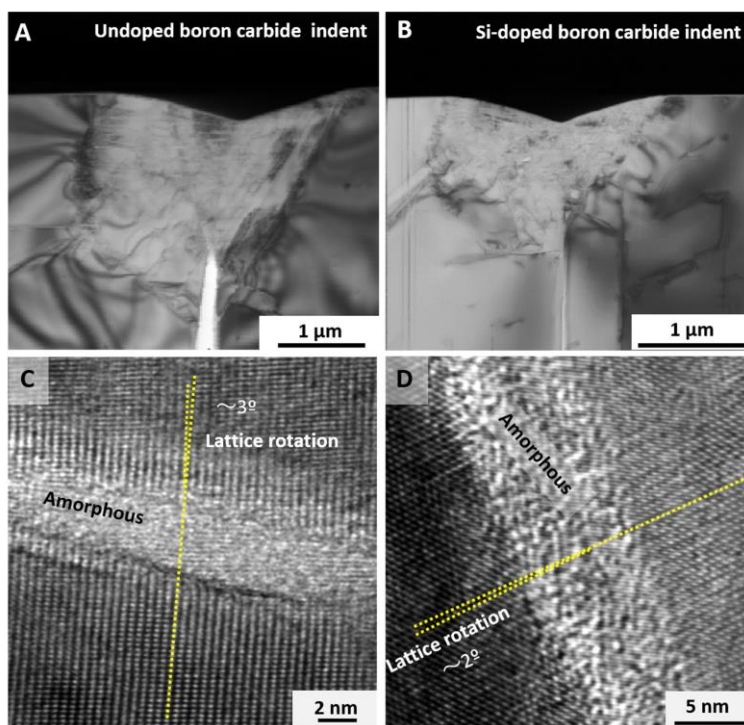


Fig. S4. TEM observation of indented undoped and Si-doped boron carbides. Low magnification virtual bright-field STEM images of indented (A) undoped boron carbide and (B) Si-doped boron carbide. HRTEM images of amorphous shear bands in (C) undoped boron carbide and (D) Si-doped boron carbide.

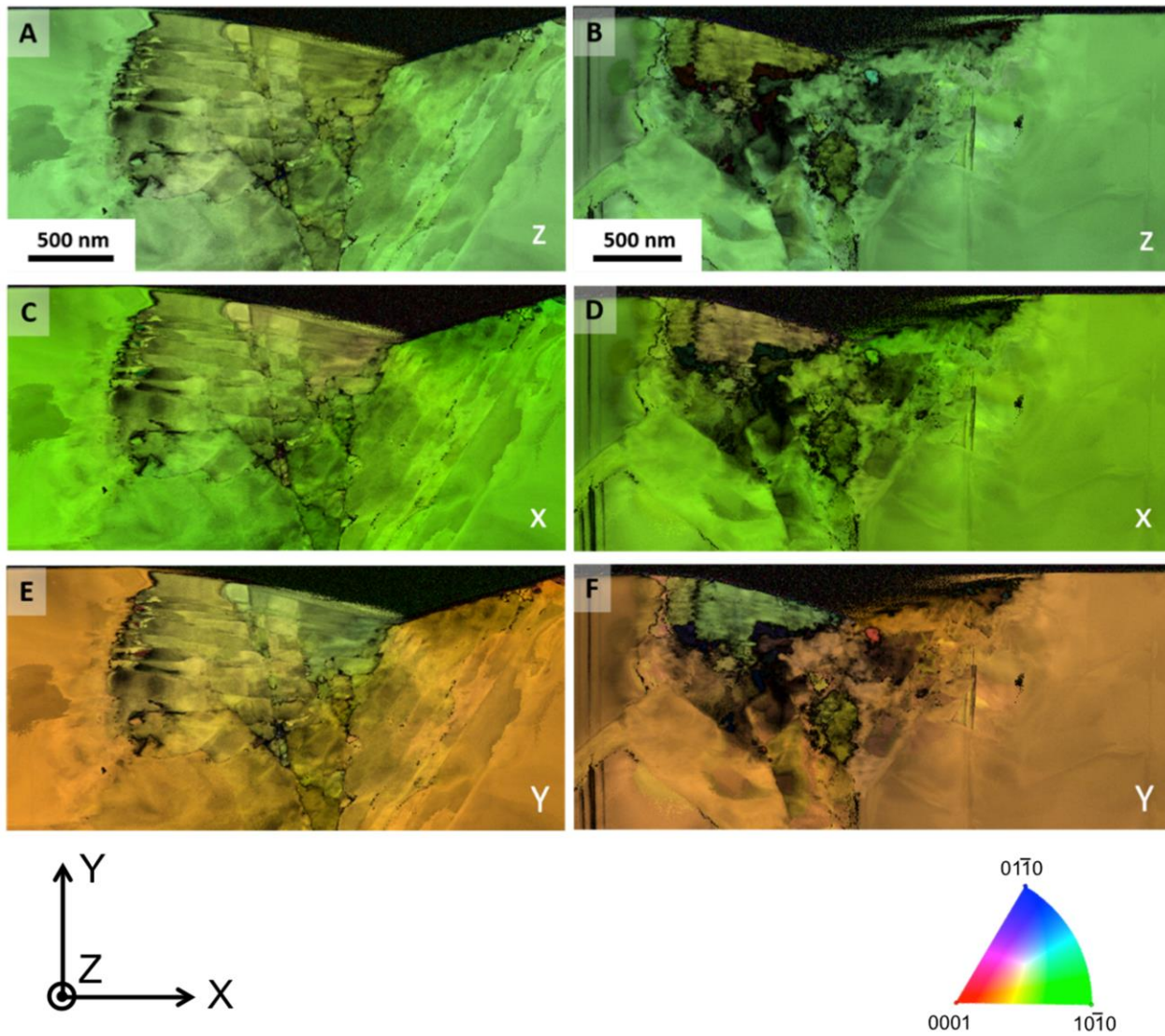


Fig. S5. Orientation maps of the quasi-plastic zones of undoped and Si-doped boron carbides. Orientation maps from Z, X and Y directions overlapped with reliability maps of (A, C and E) undoped and (B, D and F) Si-doped boron carbide.