**Room Temperature Compression of Glassy Carbon**

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Introduction.

Diamond and diamond-like materials are found in many industrial processes due to their extreme hardness, and how diamond is formed has been the subject of extensive research. Techniques for diamond synthesis include the high pressure/high temperature method, chemical vapour deposition, and detonation of carbon-containing explosives. However, all synthesis routes require both high pressures and high temperatures or another type or another type of external stimuli. In our recent works, we report the plastic transformation of glassy carbon (GC) after room temperature (RT) compression to above 45 GPa [1] as well as the transformation from GC to hexagonal diamond at a record low temperature of 400°C due to a shear-driven mechanism [2]. In this study, GC is compressed to far above 45 GPa at RT, with several phases of C being observed in the recovered sample as measured using Raman microspectroscopy, x-ray diffraction, and transmission electron microscopy (TEM). This provides a transformation mechanism and pathway for these phases with no external heating or stimuli.

Results.

*In situ* optical transparency and Raman measurements suggest a transformation to a diamond-likes structure at as low as 60 GPa. However, the transparency is not retained upon decompression, suggesting at least a partial transformation to graphite-likes structure. Indeed, cross-sectional TEM indicates the sample is comprised of a graphite-like matrix that contains veins of diamond-like material in regions of high shear. Such regions are present as veins of varying size, with the size of the vein reflecting the amount of shear-strain present at its formation. Veins of increasing size show an evolution of different phases being present, allowing for a greater understanding of the transformations occurring with increasing shear.

**References**

1. Shiell, Tom B., et al. "Graphitization of glassy carbon after compression at room temperature." Physical review letters 120.21 (2018): 215701.
2. Shiell, Thomas B., et al. "Nanocrystalline hexagonal diamond formed from glassy carbon." Scientific reports 6 (2016): 37232.