Evidence for melting in glassy carbon at high pressures and temperatures.

Cook, B.[1], Shiell, T.[2], Mckenzie, D.[3], Haberl, B.[4], Karandikar, A.[5], Boehler, R.[5], Bradby, J.[2] and Mcculloch, D.[1]

[1] School of Science, RMIT University, Australia, [2] Department of Electronic Materials Engineering, Research School of Physics and Engineering, The Australian National University, Australia, [3] School of Physics, The University of Sydney, Australia, [4] Chemical and Engineering Materials Division, Oak Ridge National Laboratory, United States, [5] Geophysical Laboratory, Carnegie Institution of Washington, United States

The carbon pressure-temperature (P-T) phase diagram has been studied for many years [1]. However, there remains controversy about the location of the melting line between the cubic diamond phase and the liquid phase of carbon also known as the diamond melting line [1]. In this study, electron microscopy is used to study the microstructural changes in glassy carbon when subjected to high pressures and temperatures in order to provide new insights into the carbon P-T phase diagram.

Small pieces (~ 150μm x 150μm x 80μm) of glassy carbon were placed into a diamond anvil cell (DAC) with an argon (Ar) pressure medium and compressed to pressures up to 35 GPa. A high powered pulse laser was used to heat the samples from 2000-5500K. *Ex-situ* analysis of the samples using scanning electron microscopy revealed that there were small voids present in some samples which may be evidence that the sample had melted when heated above certain temperatures. Detailed analysis of lamella prepared using a focused ion beam and analysed using transmission electron microscopy revealed that these voids were filled with Ar. The presence of Ar "bubbles" provides strong evidence the sample had melted and while in the liquid state Ar was trapped when the material re-crystallised into diamond.

[1] F.P. Bundy, W.A. Bassett, M.S. Weathers, R.J. Hemley, H.U. Mao, A.F. Goncharov, The pressure-temperature phase and transformation diagram for carbon; updated through 1994, Carbon, 34 (1996) 141-153.

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