GENERATION AND DIAGNOSTICS OF THE GRAPHITE MELTING UNDER HIGH PRESSURE

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The number of reviews have been devoted to the study of graphite melting in recent years, for example, [1,2] and books [3,4]. Pressure at the triple point of carbon (gas-liquid-solid) according to experimental data [5] is 120 bar. In most direct experiments (at relatively low pressures of 1-4 kbar), the melting point of graphite is from 4800 to 5000 K. The enthalpy at the beginning of melting is ∼10.5 kJ/g, and at the end ∼20.5 kJ/g.

In the computational and experimental study [6], the thermal expansion of graphite was measured by the interferometric method only at the central point of a flat graphite sample. Moreover, the sample was clamped between two plates of silica-glass (or sapphire), and additional glasses were pasted on the sides (the cell description is not available in the publication [6]), preventing one-dimensional expansion perpendicular to the graphite plane. To calculate the pressure in the cell [6], the equation of state of graphite was used, taking into account the measured expansion. A graphite melting line was obtained at pressures from 3 kbar to 18 kbar, and these pressure values corresponded to the temperatures of the beginning of graphite melting: 6300 and 6800 K. These data differ significantly from all known data in the literature. We note only two cases out of a number of such differences.

1. For example, in [6] for the starting section of the melting line ($P \sim$ 3 kbar; $T \sim$ 6300 K), the input energy for the start of melting is 13 kJ/g. For comparison, we note that in the Bundy experiment [7] at a pressure of 48 kbar, the beginning of melting was recorded at 13.2 kJ/g, and not 10.5 kJ/g (as usual, at not very high pressures).

2. When graphite is heated in thick-walled sapphire tubes [8], the melting point of graphite was measured as 6200 K. The pressure estimate in these experiments according to $dP/dT = 27$ bar/K [5] gives ∼37 kbar, and according to $dP/dT = 50$ bar/K [9] leads to a pressure value of $P \sim 50$ kbar.

These comparisons show that in [6] there are gross errors in the pressure calculation, which led to unreliable results for the graphite melting curve. However, Indicator.Ru, who is not an expert and, apparently, has no idea about the history of graphite research, published in the media his opinion about the work [6] under the title: “For the first time, the properties of liquid carbon have been investigated” [10].

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