

Impulse laser cutting of diamond accompanied by phase transitions to fullerene-type onions

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We studied a process of diamond cutting by a focused pulsed laser beam in an explosion inside solid matter mode (a 100-ns laser beam impulse focused in diamond generates a shock wave). A cavity size created in diamond by the laser impact is described by a conception of a blast cavity formation after explosion inside solid matter. Diamond cutting is also accompanied by a phase transition from diamond to fullerene-type onions composed of 2 to 5 shells. According to a new phase diagram of carbon [1, 2] (which contains a zone of diamond instability in the 55–115 GPa pressure range), the observed phase transition is possible under 70 GPa pressure and 2400 K temperature, which indicates pressure and temperature values during laser cutting. The pressure estimated based on the new phase diagram corresponds to the pressure estimated from the known blast cavity formation model.

[1] Popov M Y, Churkin V D, Kulnitskiy B A, Kirichenko A N, Bulatov K M, Bykov A A, Zinin P V and Blank V 2020 *Nanotechnol.* **31** 315602

[2] Blank V D, Churkin V D, Kulnitskiy B A, Perezhogin I A, Kirichenko A N, Denisov V N, Erohin S V, Sorokin P B and Popov M Y 2018 *Nanotechnol.* **29** 115603