



Volume 2, No 2, p. 27 – 36 (2014)

Mathematical Modeling of Graphite-to-Diamond Transition

E.M. Sarkisyan¹, K.B. Oganessian^{1,2,a}, N.Sh. Izmailian¹ and
E.A. Ayryan²

¹ Yerevan Physics Institute, Alikhanian Brothers 2, 375036 Yerevan

² Joint Institute for Nuclear Research, Dubna, Russia

e-mail: ^absk@mail.yerphi.am

Abstract. The energetic evaluations of graphite-to-diamond transition by electron irradiation are performed. The heat conduction problem is solved for the diamond synthesis when a pulse-periodic source of energy is located within a graphite cylinder; time dependences of temperature and pressure are found. It is shown, that the temperatures and pressures implemented in graphite are sufficient for graphite-to-diamond transition under electron bombardment.

Keywords: graphite, diamond, phase diagram

PACS numbers: 05.50+q, 75.10-b

E.A. Ayryan is grateful for the support from the Russian Foundation for Basic Research, grants No. 14-01-00628 and No. 13-01-00 595.

References

- [1] Batsanov S.S., Demidov B.A. and Rudakov L.I. *Use of a high-current relativistic electron beam for structural and chemical transformations* . Pisma v ZhETF 1979 **30**, pp. 611-613; JETP Lett. 1979 **30**, 575–577
- [2] Batsanov, S.S., Demidov, B.A., Ivkin, M.V., Kopaneva, L.I., Lazareva, E.V., Martynov, A.I., Petrov, V.A. *Carbide synthesis and phase transition of boron nitride under the influence of high current density relativistic electron beam*. Izvestiya Akademii Nauk SSSR, Neorganicheskie Materialy 1990, **26**, N 10, pp. 2100–2102; Inorganic Materials 1990, **26**, N 10, pp. 2100–2102
- [3] Amatuni A. Ts. *Nonlinear effects in plasma wake field acceleration (PWFA)* in Proc. of Workshop on Role of Plasmas in Accelerators 1989, Tsukuba, Ibaraki: National Lab. for High Energy Physics, pp. 81-97
- [4] Zel'dovich Ya.B. and Raiser Yu.P. *Physics of shock waves and high-temperature hydrodynamic phenomena*. N.-Y.: Academic Press, V 1, 1966. 464 p.; V. 2, 1967. 451 p.
- [5] Altshuller L.B., Krupnikov K.K., Brazhnik M.I., *Dynamic compressibility of metals under pressures from 400,000 to 4,000,000 atmospheres*. Sov. Phys. JETP, 1958, **7**, pp. 614-619
- [6] Coll. *Superhard synthetic materials*. 1986, **1** p.35, Kiev: Naukova Dumka (in Russian)
- [7] Kurdyumov A.V. and Pulyancevich A.N. *Phase transition in carbon and nitride of boron*. 1979, Kiev: Naukova Dumka, p.127 (in Russian)
- [8] *Stopping power of electrons and positrons*. **37** Report MKRE 1987, Moscow: Energoatomizdat (in Russian);
- [9] Jaeger D. and Carlsaw H. *Conduction of Heat in Solids*. 1959, London: Oxford University Press
- [10] L. Hormander, *An introduction to complex analysis in several variables* , North-Holland 1973;
- [11] Abramovits M., Stegun I.A. *Handbook of Mathematical Functions* 1972, New York: Dover;
<http://dlmf.nist.gov/NIST Digital Library of Mathematical Functions>
- [12] Gradstein I.S. and Ryzhik I.M. *Tables of integrals, Series and Products*. 1966, New York: Academic