

POSSIBLE TRANSITION OF DIAMOND INTO THE METALLIC STATE

L.F. Vereshchagin, E.N. Yakovlev, G.N. Stepanov, and B.V. Vinogradov
Institute of High Pressure Physics, USSR Academy of Sciences
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It is known that diamond is a semiconductor with a broad forbidden band (~ 5.6 eV).

If account is taken of the low compressibility of diamond, then the dielectric-metal transition can be expected to be realized at appreciable pressures.

After we had constructed [1] apparatus developing static pressures of several megabars (by compressing Bridgman anvils made of "carbonado"), we performed experiments aimed at assessing the possibility of natural diamond becoming metallic under pressure.

A suspension of natural diamond powder (grain dimension $\sim 3 \mu$) in acetone was deposited on the surface of a flat anvil. After evaporation of the acetone, we obtained a thin continuous layer of diamond powder, which was compressed with the aid of another conical anvil with apex angle 168° . To avoid "puncturing" of the diamond film, the apex of the cone was rounded off at radius ~ 0.1 mm.

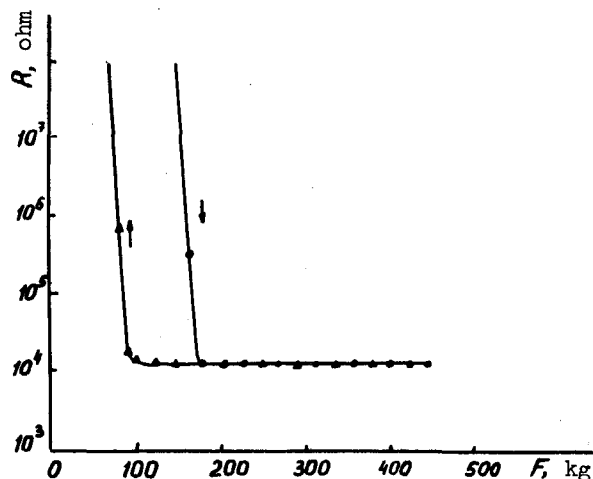
With increasing force, the electric resistance of the sample dropped jumpwise from a value exceeding 10^7 ohms to $10^4 - 10^2$ ohms.

Experiments repeated many times yielded a resistance-pressure hysteresis loop, and the resistance of the diamond resumed its initial value after the pressure was removed (figure).

Direct contact between the anvils ("puncture") was observed in some cases. Then the resistance decreased rapidly with increasing force applied to the anvils, and remained practically unchanged when the force was removed.

Our experiments indicate apparently that at pressures on the order of 1 Mbar we have observed a transition of diamond into the metallic state. Experiments in this direction are being continued.

- [1] L.F. Vereshchagin, E.N. Yakovlev, K.Kh. Bibaev, G.N. Stepanov, and B.V. Vinogradov, ZhETF Pis. Red. 16, 240 (1972) [JETP Lett. 16, 169 (1972)].



Electric resistance of diamond powder (3μ) placed between Bridgman anvils vs. the applied force: \bullet - increasing force, \blacktriangle - decreasing force.