to be related to the tensile strength provided that the Weibull modulus, the number of cracks per unit volume and the exact proportion of cracks that should fail prior to material failure, are known. This information may be experimentally forthcoming, in the near future, using acoustic emission devices.

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A. de S. JAYATILAKA*
V. K. N. NANAYAKKARA
University of Moratuwa,
Sri Lanka

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[*] Formerly at the University of Sussex, Brighton, UK.

Diamond synthesis from carbon precursor by explosive shock compression

Several reports deal with the conversion of graphite to diamond by shock compression treatment [1, 2]. The transition between the two carbon phases has been described in terms of a diffusionless mechanism, i.e., a martenstic transformation. Therefore, natural and artificial graphite powders have been used as starting materials for diamond synthesis using explosive shock compression.

In this experiment, an attempt was made to produce diamond from a carbon precursor containing a small amount of vapour by shock compression since this area has remained previously unstudied.

The carbon precursors used as starting materials were produced from furfural resins. The resins were heat-treated at 500 and 600° C for 3 h in a nitrogen atmosphere. The carbon precursors contained a small amount of oxygen, hydrogen and nitrogen in addition to carbon as shown in Table I.

The carbon precursors were ground and passed through a 300 mesh sieve. The powders were mixed with 300 mesh Cu powder in a ratio of 4:96 by weight. The mixture was mechanically compacted in a stainless steel capsule at 392 MPa to form a disc 4.0 mm thick and 12 mm in diameter with a density of about 6.8 g cm^{-1}. The capsule was shock compressed by a plane-wave generator, sometimes called the "mouse-trap" [3–5]. A projectile of 3.2 mm thick iron plate was propelled at a velocity of 3.6 km sec^{-1} against the capsule. The impact pressure induced in the capsule was estimated to be about 100 GPa using an impedance matching method [5].

The shock compressed disc specimens were immersed in dilute HNO_3 for 24 h to dissolve the copper matrix. The remaining black powder was oxidized for several hours with a hot solution of concentrated HNO_3 with a small amount of sodium chlorate to dissolve unconverted carbon. Light grey silver powder was obtained. When fractions of these powder specimens were rubbed

TABLE I Chemical analysis of the carbon precusors heat-treated at 500 and 600° C

Component	Percentage component	
	500° C	600° C
Carbon	87.45	92.13
Oxygen	8.83	5.08
Hydrogen	3.52	2.53
Nitrogen	0.20	0.26

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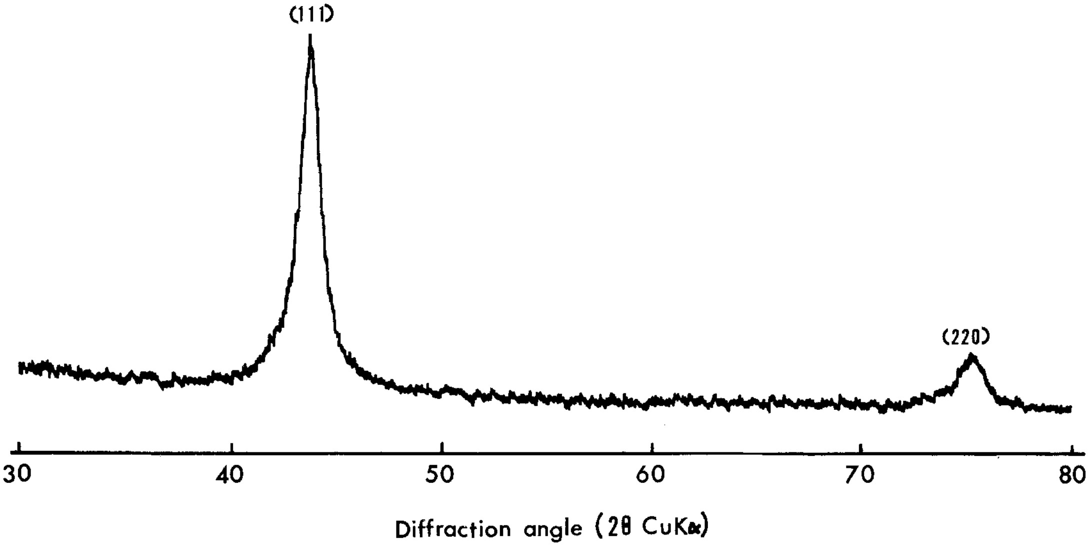

Figure 1 The typical X-ray diffraction pattern of the cubic diamond transformed from the carbon precursor heat-treated at 500° C.

between a polished sapphire and a glass slide, many scraches appeared on both surfaces.

The specimens were examined by means of X-ray and transmission electron diffraction. Fig. 1 shows a typical X-ray diffraction pattern obtained from the specimens using CuKα radiation. Only the 1 1 1 and 2 2 0 diffractions corresponding to a cubic diamond were observed from the patterns. Fig. 2 shows typical electron diffraction patterns of these specimens. Many of the particles gave diffuse ring patterns which corresponded to a cubic diamond reflection as shown in Fig. 2a. Occasionally, the ring reflection was made up of spots, indicating coarse crystallites, as observed in Fig. 2b. The *d*-value obtained from these patterns indicated close agreement with the reflection produced by cubic diamond. In this experiment, no traces of hexagonal diamond was detected from the shock compressed specimens.

The X-ray diffraction patterns of the carbon

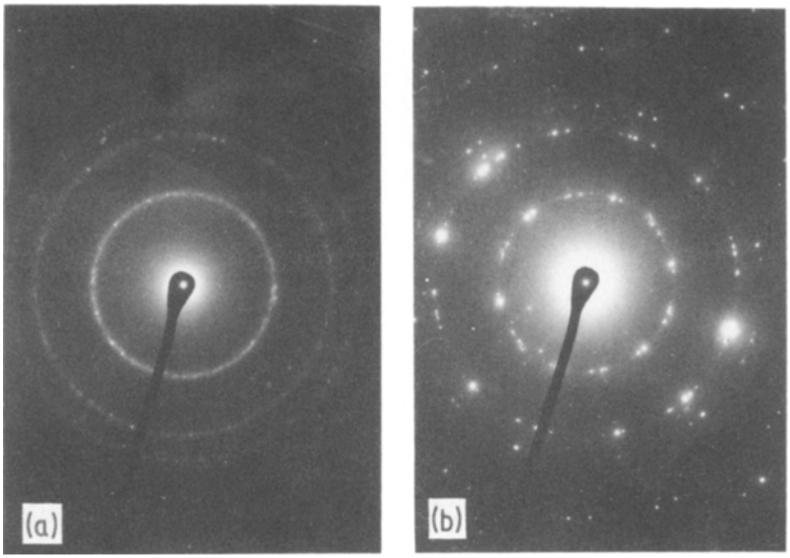

Figure 2 The typical electron diffraction patterns of the cubic diamond transformed from the carbon precursor. (a) diffuse ring pattern and (b) ring diffraction pattern made up of spots.

precursors used as starting materials gave only a very broad peak at about $2\theta = 19°$, which is far from the 002 reflection produced by graphite. The structure model of the glassy carbon has been proposed by several investigators [6, 7]. The models are derived from results obtained from the radial distribution curve of glassy carbon heat treated at various temperatures between 500 and 3000° C. Noda and Inagaki [6] proposed the model consisting of a large amount of tetrahedral carbon atoms and a number of small domains of trigonal carbon atoms. The model of Furukawa [7] consists of a three-dimensional irregular network configuration which contains all kinds of C–C bonds. The trigonal carbon atom content in glassy carbon increases on raising the heat treatment temperature.

The present experiments gave evidence for the conversion of the carbon precursor to the diamond phase when it was subjected to strong explosively generated shock. This suggests that the cubic diamond may be synthesized by a mechanism other than the diffusionless mechanism or martenstic transformation.

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NUBUO SETAKA
YOSHIZO SEKIKAWA
National Institute for Researches
in Inorganic Materials,
Namiki 1-1, Saknia-mura,
Ibaraki,
Japan

Leached "Syndite" (sintered diamond) as a heat sink material

Some electronic devices are kept cool by mounting them on thin slices of type-2a diamond which act as heat spreaders and are commonly called heat sinks. Whilst this is a successful technique it is only commercially viable for slices up to about 1 mm square. The electrical insulation of the diamond is sometimes important. Other electrically insulating heat sinks are made from beryllium oxide for which there is less limitation on size, but its heat conductivity [1] is not as high as diamond and the material is toxic. This note discusses the possibility of making large heat sinks from the sintered diamond products which are now commercially available and which are known to have a high thermal conductivity [2]. This suggestion has also been made by Pope *et al.* [3, 4].

Most of the sintered diamond materials have a metal matrix (usually cobalt) and so they are electrically conducting. The metal therefore has to be leached out (from the surface at least) if an electrically insulating heat sink is required.

In our investigations the de Beers sintered diamond product "Syndite" was used. The cobalt content before and after leaching was determined both by magnetization measurements (Oxford) and by neutron activation analysis (Amsterdam). The leaching was done with hot aqua regia in a pressure vessel followed by fused sodium nitrate (Oxford) and by hydrofluoric acid and hot aqua regia (Amsterdam). The initial cobalt content was about 12 wt% (5.5 vol%) which reduced to values in the range 2 to 6 wt% after leaching. The electrical resistivity which was originally of the order of 10^{-2} ohm m, increased to about 10^{4} ohm m, although in one or two samples the resistivity

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