Table 2
The Variation of Particle Size with Position in Each Capsule

Sample	*Particle size range* (μm)	*Average particle size* (μm)	*Comments*
A1	0·1– 5	1–2	Some crystallographic shapes retained.
A2	0·1– 5	2–3	Wide size distribution.
A3	0·1– 8	1–2	Wide size distribution.
A4	0·1– 8	1–2	Small size distribution.
A5	0·1– 8	2–3	Small size distribution. Cracking present.
A6	0·1– 5		Small size distribution. Many "chippings" present.
B1	0·2– 6	1·5	Some crystallographic shapes retained. More cracks than in A and C samples. Many very small particles in sample B3.
B2	0·2– 6	2·0	
B3	0·1– 5	1·5	
C1	0·1– 6	2–3	Some crystallographic shapes retained.
C2	0·1–10		Wide size distribution. Many "chippings" present.
C3	0·2– 8	2–3	Wide size distribution. Cracking present.
C4	0·1– 5	1–2	Small size distribution. Cracking present.
C5	0·1– 5	1–2	Small size distribution.
C6	0·1– 5	2–3	Small size distribution. Many "chippings" present.
Unmilled	0·5–10	3–4	Large rounded particles.
Glen-Creston milled (8 h)	0·1– 4	0·5–1·0	Many fragments with a few large particles.

fractures occurring perpendicular to the axis of the cylinder. The largest piece was used for firing. The one originating from the 'as received' sample was extremely fragile and also broke up in a similar fashion on handling. The compact made from the milled material pressed well.

The three specimens were fired at 1725°C for 30 h in a molybdenum tube furnace in a wet hydrogen atmosphere (flow rate: 20 ft^3h^{-1}). The average heating-rate from room temperature was approximately 250°C h^{-1}.

2.4 Density Measurement

First the absence of continuous porosity was established by confirming zero absorption of methyl alcohol. The densities were then determined by a flotation method using Clerici "A" solution in a test tube suspended in a constant-temperature water bath at 30°C. The solution was slowly diluted with distilled water at 30°C and thoroughly stirred. When the specimen began to fall and remain suspended, the density of the solution was measured with a density bottle also immersed in the water bath.

3. RESULTS

3.1 Strain and Powder Characteristics

Values of strain and strain energy, derived as described in Section 2.2, are shown in Table 1 together with values of measured crystallite size and calculated equivalent surface energy. Since the method of sampling chosen for X-ray analysis was elaborate and the total weight of shocked powder in each capsule was small (~2 to 4 g), a detailed analysis of the strain and crystallite size was not possible on all the samples (~0·5 g of powder is required for each diffractometer specimen).

For capsule A, in which the amount of alumina powder was smallest, microdensitometry showed that the line broadening on the X-ray powder patterns for all the samples from this capsule was approximately the same. Hence the level of strain appears to be constant throughout the volume of the encapsulated powder. In consequence one diffractometer specimen was made from powder collected from all positions within the capsule.

For capsule C it was possible to make suitable diffractometer specimens from samples C3 to C6, and full Williamson–Hall strain analyses were carried out. The line broadening exhibited on the powder patterns of the remaining two samples C1 and C2 indicated that the levels of strain were slightly less than that in sample C3. Figures for these strain values were estimated by comparison with the powder patterns of the other samples and with powder patterns of other alumina specimens with known strain values. These values are shown in Table 1 as starred values.

The powder patterns of the three samples from capsule B (with only one layer of explosive) indicated that the levels of strain in the powder in this capsule were less than those in capsule C and considerably less than those in capsule A. In consequence it was decided to estimate the strain levels by the method outlined above. Again these values are starred in Table 1.

Particle-size determinations made on all the samples by suitable dispersion and examination in the electron microscope are presented in Table 2 and Figure 2.