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18.—Explosive Shocking of Alumina Powder

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ABSTRACT

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Alumina powder has been subjected to high-energy explosive shocking causing a reduction in the particle size. Some of the shocked particles showed residual cracks. High strain levels have been measured by X-ray diffraction line broadening but experiments designed to assess the effect of the additional strain energy on the sintering behaviour are inconclusive.

Traitement de poudre d'alumininm par choc explosif

De la poudre d'alumine a été soumise à un choc explosif de haute énergie provoquant une réduction de la dimension des particules. Quelques unes des particules exposées au choc présentaient des fissures résiduelles. Les niveaux de déformation élevés ont été mesurés par élargissement des raies de diffraction des rayons X, mais des expériences destinées à établir l'effet de l'énergie de déformation supplémentaire sur le comportement de la poudre au frittage n'ont pas donné de conclusions.

Explosive Stoßbehandlung von Aluminiumoxidpulver

Aluminiumoxidpulver wurde einer hochenergetischen explosiven Stoßbehandlung unterworfen mit dem Ergebnis einer Teilchengrößenverkleinerung. Einige der geschockten Partikel enthielten bleibende Risse. Hohe Verformungsgrade konnten aus der Röntgenlinienverbreiterung gemessen werden. Experimente, die den Einfluß der zusätzlichen Verformungsenergie auf das Sinterverhalten zeigen sollten, waren jedoch nicht schlüssig.

1. INTRODUCTION

Recent investigations have shown that mechanical working, for example ball-milling, can introduce appreciable microstrains in a wide variety of powdered materials.[1–3] The presence of strain has been shown to influence the sintering activity of a powder [4] and may explain differences in behaviour between two apparently identical powders.

It has been established [5] that, to produce large strains, severe and prolonged milling treatments are necessary. Explosive shocking [6–8] offers an alternative technique of inducing strain.

Bergmann and Barrington [6] studied the effects of explosive shocking on a range of materials including magnesia and alumina. They suggested that a large portion of the observed X-ray line broadening was caused by the introduction of micro-strain in the powder particles. Heckel and Youngblood [7] carried out full Fourier analyses of the total line broadening of the X-ray diffraction patterns from explosively treated magnesia and alumina powders. Their results confirmed that the broadening in these two materials is due mainly to strain, and to a lesser extent to reduction of crystallite size.

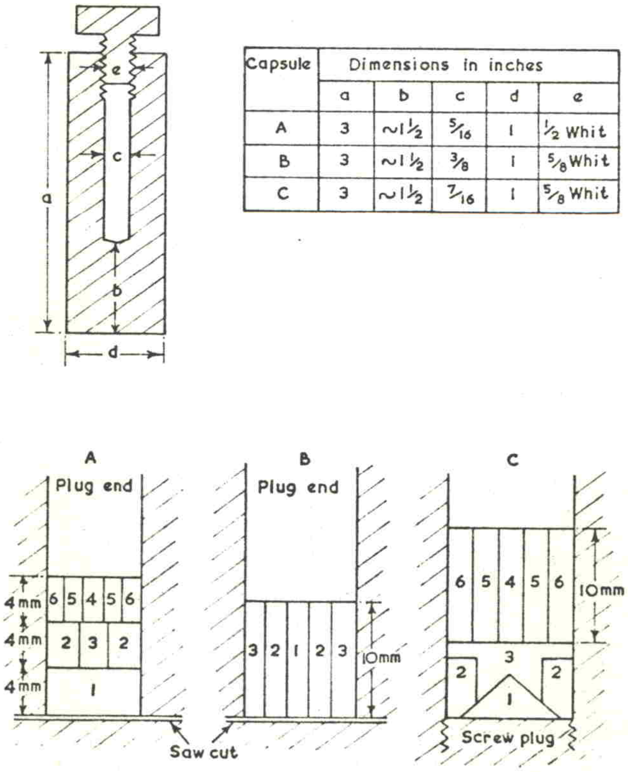
In the present investigation α-Al_2O_3 powder has been chosen with which to study further the effect of high-energy explosive shocking. X-ray diffraction, electron-microscope and sintering studies have been undertaken to assess the effects of this treatment on the powder characteristics and behaviour.

2. EXPERIMENTAL

2.1 Explosive Shocking

Containers were made from 3-in. lengths of 1-in. diameter mild steel rod drilled out to form closed cylindrical cavities of various wall thicknesses as shown in Figure 1. The powder was packed using a hammer and punch and the capsule was closed by a screw tightened down on to the powder. Capsule B was wrapped with a single layer of sheet plastic explosive whereas capsules A and C were wrapped in a double layer. After detonation, only one of the capsules (C) could be unscrewed. The other two were opened by sawing off the closed end, as indicated in Figure 1.

The powder could be removed from the capsules without great difficulty. Where the powder was in



Capsule	Dimensions in inches				
	a	b	c	d	e
A	3	~1½	5/16	1	½ Whit
B	3	~1½	3/8	1	5/8 Whit
C	3	~1½	7/16	1	5/8 Whit

Figure 1

Capsule dimensions and sample positions.