Penetration Twins in Synthetic Coesite

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Abstract

Two types of penetration twins were observed in coesite synthesized from amorphous silica, cristobalite, or quartz at 30 kbar and 600° to 1300°C, one with (121) and the other with (233) as the twin plane. Effects of added water and treatment temperature on twin growth were studied. Occurrence of twins may be attributed to preferential growth along the c axis of coesite.

Introduction

In synthetic coesite, simple contact twins with (021) as the composition and twin plane are fairly common (Ramsdell, 1955; Sclar, Carrison, and Schwartz, 1962). Ramsdell also observed (100) twinning. Khitarov et al (1957) sketched cross-like intergrowths but without morphological evidence. Two new types of penetration twins in synthetic coesite are here described.

Penetration Twins

The girdle-type high-pressure apparatus and experimental method used in this work have already been described (Naka et al, 1974a, b). The coesite was prepared from amorphous silica, cristobalite, or quartz at 30 kbar and 600° to 1300°C. Optical studies revealed two types of penetration twins (Fig. 1). The twin plane is (121) for one (Fig. 1A) and (233) for the other (Fig. 1B), as determined from coesite's axial ratio, \( a:b:c = 0.58:1:0.58 \). Under crossed nicols both types consist of two idiomorphic individuals of approximately equal size, each individual being elongated parallel to the c axis. Some of the crystals have (010) cleavage (Fig. 1B). Subconchoidal fractures were also observed perpendicular to the c axis, as shown by Sclar et al (1962). The optical orientation of coesite is \( X = b \) and \( Z \wedge c = 4°-6° \). The optical angle \( 2V_z \) was determined with a universal stage to be 66.5°.

Penetration twins occur more frequently in coesite prepared under anhydrous rather than hydrous con-
Furthermore, the growth of the twins is affected by treatment temperature. No twins were observed in coesite synthesized anhydrously from quartz at 30 kbar and 900°C for one hour. However, twins were observed in coesite prepared under the same conditions but at 1300°C.

The present experimental condition of synthesis is probably comparable to that of the formation of coesite inclusions in natural diamond. Therefore, there is some possibility of natural occurrence of the penetration twins. However, because of the very small grain-size of natural coesite, no reports on its morphology have been published.

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References


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