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Transformation of SiO_2 to the amorphous state by shearing at high pressure

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ABSTRACT

A natural α-quartz disc with flat surfaces perpendicular to (100) was sheared at 5 GPa in order to confirm that the sheared state at high pressure is not always the same as that obtained at high hydrostatic pressure. A transmission X-ray diffraction pattern taken from the sample that was sheared at high pressure revealed five broad halo rings; the pattern was taken about three months after the high-pressure experiment. The ratios of the interplanar spacing corresponding to the densest radius of the smallest ring to those of the other ones are 0.610, 0.514, 0.459, and 0.399, respectively. This set of rings does not appear from α-quartz. These are approximately equal to those obtained from solids with space group *Fd*3*m*. A Raman spectroscopic study also showed the structural change due to shearing at high pressure. The spectrum appears neither from α-quartz nor from coesite. These facts indicate, therefore, that the crystalline α-quartz sample transformed to the amorphous state based on a structure consistent with *Fd*3*m* space group.