Influence of light power density on realgar alteration, and the experimental verification of the phase transformation model

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Correlation between light induced alteration of arsenic sulfide (mineral name: realgar, As_4S_4) and irradiated light intensity was investigated using in situ single crystal X-ray diffractometry. The exposure time required for the phase transformation increases gradually as the light intensity decreases. The X-ray diffraction intensities of (261) and (361) reflections decrease sharply, indicating that the As-As bonds in As_4S_4 molecules are broken by insertion of an additional S atom. The As-As bond cleavage and As_4S_4 molecule deformation are largely produced throughout the crystal structure when the unit cell volume reaches approximately 802 A^3, followed by rearrangement of the As_4S_4 pararealgar molecular packing. It continues until the unit the cell volume expands continuously to approximately 810 A^3. The feature of the continuous increase of the a cell parameter was observed within the light intensity range. The value of the b cell parameter remained constant during light treatment. Nevertheless, the linear increase in the c sin(beta) value was not confirmed as the light intensity decreased. Variation of the unit cell volume correlates with that of the c sin(beta) value. Consequently, no continuous increase of unit cell volume was apparent in realgar exposed to light of 5 W/m^2. Such a discontinuous increase in c sin(beta) value is attributed mainly to the value of the c cell parameter, which varies widely with light exposure. The highest sensitivity for lighting is shown at the a and (beta) angles in unit cell parameters. It increases or decreases linearly up to the loss of crystallinity.

References

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