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# Phase transitions induced by solid solution in stuffed derivatives of quartz: A powder synchrotron XRD study of the $LiAlSiO_4$-$SiO_2$ join

**HONGWU XU[1,*], PETER J. HEANEY[2], AND GEORGE H. BEALL[3]**

[1]Department of Geosciences and Princeton Materials Institute, Princeton University, Princeton, New Jersey 08544, U.S.A.
[2]Department of Geosciences, Pennsylvania State University, University Park, Pennsylvania 16802, U.S.A.
[3]Corning Incorporated, Sullivan Park FR-51, Corning, New York 14831, U.S.A.

## ABSTRACT

The crystal structures of stuffed derivatives of quartz within the $Li_{1-x}Al_{1-x}Si_{1+x}O_4$ system have been refined by Rietveld analysis of powder synchrotron X-ray diffraction (XRD) data. Our results reveal an Al-Si order-disorder transition at x = ~0.3 and a β-α displacive transformation at x = ~0.65. Structural variations across the series result from an interplay of three mechanisms: tetrahedral tilting associated with Al-Si order-disorder; Li positional disorder along structural channels parallel to **c**; and tetrahedral rotation related to the β-α transition. At both microscopic (local bonding) and macroscopic (spontaneous strain) scales, the substitution of $Li^+$ and $Al^{3+}$ for $Si^{4+}$ closely mimics temperature in its effect on the quartz framework.