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# Memory effects of domain structures during displacive phase transitions: A high-temperature TEM study of quartz and anorthite

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## Abstract

Memory effects associated with the Dauphiné twins in α quartz and the c-antiphase domains (c-APDs) in $P\bar{1}$ anorthite have been investigated by in situ hot-stage transmission electron microscopy (TEM). In a set of kinetic experiments, specimens were cycled about their transition temperatures, and changes in the Dauphiné twin and c-APD positions were analyzed as a function of maximum annealing temperature and annealing time. The results indicate that Dauphiné twins are strongly pinned by extended defects, such as Brazil twin and grain boundaries, dislocations, and surfaces. However, the memory displayed by Dauphiné twin boundaries pinned by point defects degrades with higher annealing temperatures and longer annealing times. An Arrhenius analysis of this behavior yielded an average activation energy for point-defect diffusion of 68.6 kJ/mol.

In contrast to the Dauphiné twins of quartz, the c-APDs of anorthite did not appear to interact strongly with extended defects, and they exhibited a nearly perfect memory for all annealing times and temperatures tested. This extremely high fidelity is interpreted as evidence that the positions of c-APDs are fixed by localized Al-Si disorder, which remains unchanged when anorthite is heat treated at <1000 °C.