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A transmission electron microscope investigation of the $C2/c \rightarrow P2_1/c$ phase transition in clinopyroxenes along the diopside-enstatite ($CaMgSi_2O_6$-$Mg_2Si_2O_6$) join

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ABSTRACT

A transmission electron microscope investigation was performed on a series of synthetic clinopyroxenes with compositions between $Ca_{0.7}Mg_{1.3}Si_2O_6$ and $Ca_{0.5}Mg_{1.5}Si_2O_6$. For samples with Ca content lower than 0.6 atoms per formula unit (apfu) selected-area electron diffraction (SAED) patterns showed the presence of reflections violating the $C2/c$ space group (b type, $h+k$ odd), indicating a transition to the $P2_1/c$ symmetry at room temperature. Antiphase domains induced by the transition could be imaged, with irregular boundaries and size decreasing with increasing Ca content. The antiphase domain size and shape appears unrelated to the non-periodic mottled texture that could be imaged in samples with Ca lower than about 0.65 apfu.

A comparison with data reported in the literature suggests a different behavior in the cell parameters of the $P2_1/c$ clinopyroxenes along the diopside-enstatite (Di-En) join. For compositions between $Di_{60}En_{40}$ to about $Di_{40}En_{60}$, cell parameters deviate little with respect to the trend shown by Ca-rich $C2/c$ clinopyroxenes, whereas for compositions richer in Mg than about $Di_{40}En_{60}$, a significant deviation is present, which is marked by discontinuities in the c and β cell parameters.