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Irregular orthorhombic twins and non-switchable polarization in multiferroic $Ca_3Mn_2O_7$[1] BIN GAO, FEI-TING HUANG, YAZHONG WANG, JAEWOOK KIM, Rutgers Center for Emergent Materials, Rutgers University, LI-HAI WANG, Pohang University of Science and Technology , SEONGJOON LIM, SANG-WOOK CHEONG, Rutgers Center for Emergent Materials, Rutgers University — $Ca_3Mn_2O_7$ has been proposed as a prototypical magnet with hybrid improper ferroelectricity (HIF), and a significant magnetoelectric (ME) coupling effect in $Ca_3Mn_2O_7$ has been reported theoretically and experimentally. However, unlike the case of $Ca_3Ti_2O_7$, the switchable polarization has not been experimentally confirmed in $Ca_3Mn_2O_7$. From the systematic investigation of single-crystalline $Ca_3(Mn,Ti)_2O_7$, we found a unique irregular domain structure in $Ca_3Mn_2O_7$, stemming from the random stacking of 90-degree *a*- and *b*-domains along the *c*-axis. We determined the structural transition temperatures, and also the phase diagram. We found that $Ca_3Mn_2O_7$ and $Ca_3Ti_2O_7$ go through different routes upon structural phase transition, which results in different domain stackings along the c-axis. This random stacking of twins in $Ca_3Mn_2O_7$ appears to make polarization switching difficult.

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