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Transient magnetic states in the multiferroic frustrated spin chain compound Ca_3CoMnO_6 JAE WOOK KIM, E.D. MUN, M. JAIME, N. HARRISON, D. RICKEL, V. ZAPF, NHMFL/MPA-CMMS, LANL, J.D. THOMPSON, MPA-CMMS, LANL, Y. KAMIYA, C. BATISTA, T4/CNLS, LANL, H. YI, Y. OH, S.-W. CHEONG, RCEM/Dept. of Physics and Astronomy, Rutgers Univ. — We report the discovery of transient magnetic states in a frustrated Ising spin chain system Ca_3CoMnO_6 that are observed only within a certain range of magnetic field (B) sweep rates. Spin chains are composed of alternating Co^{2+} and Mn^{4+} spins along the c-axis and arranged in a triangular lattice in the ab-plane. At zero field, the spins order in a $\uparrow\uparrow\downarrow\downarrow$ configuration that allows for ferroelectric polarization (P). Previous work shows that when DC field is applied along the c-axis, a $\uparrow\uparrow\uparrow\downarrow$ spin structure with a 1/2 magnetization (M) plateau is stabilized around $B \sim 15$ T and P disappears. However, when applying B with various sweep rates using a 60 T shaped-pulse magnet we find transient features in the M, P, and magnetostriction ($\Delta L/L$). We found one step at 4 T with sweep rate of 75 T/s and another step at 6 T when further increasing the rate to 960 T/s, both below the M =1/2 plateau. We attribute this time dependence to the magnetic frustration from both interchain and intrachain exchange interactions between Ising-like Co^{2+} spins which can leads to the creation of magnetic microphases. Thus the evolution of M with external parameters is not a straightforward canting or rotation of spins, but could be a progression through many different ordered microphases that are close in energy. This strongly suggests that an ANNNI-like model is appropriate to describe this system.

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