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Multiferroicity with coexisting isotropic and anisotropic spins in $\mathbf{Ca_3Co_{2-x}Mn_xO_6}$ JAE WOOK KIM, Y. KAMIYA, E. MUN, M. JAIME, N. HARRISON, J. THOMPSON, G. CHERN, C. BATISTA, V. ZAPF, Los Alamos National Laboratory, V. KIRYUKHIN, H. YI, Y. OH, S.-W. CHEONG, Rutgers University — We study physical properties in $Ca_3Co_{2-x}Mn_xO_6$ (CCMO) by magnetization, magnetostriction, electric polarization, and magnetocaloric measurements under high magnetic fields. On the controversial topic of the spin state of Co, we find evidence for high spin state with $S = 3/2$ with no field-induced spin-state crossover up to 97 T. In addition, our data also indicate that Mn spins are quasi-isotropic and develop components in the *ab*-plane in applied magnetic fields of 10 T and cant until saturation at 85 T whereas the Ising Co spins saturate by 25 T. We also find transient steps that appear only within a range of magnetic field sweep rates. This feature resembles the behavior observed in isostructural compound $Ca_3Co_2O_6$ (CCO) where metastable steps appear in magnetization in non-equilibrium condition. However, CCMO has more complex magnetic interactions due to Mn spins and a different ground state compared to CCO. Our results give a different view to the magnetoelectric coupling in this material, namely the spin-flop of Mn^{4+} destabilizes electric polarization instead of a spin flip. The origin of the the transient behavior in CCMO is also discussed.

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