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ABSTRACT

Multiferroic behavior is observed in layer-structured Aurivillius phase ceramics $B_{5.25}L_{0.75}F_{1-x}C_{1-x}O_{18}$ ($x = 0.1, 0.2, 0.3, 0.4$) at room temperature. The $B_{5.25}L_{0.75}F_{1-x}C_{1-x}O_{18}$ ceramics exhibit a transition from a paraelectric (PE) state to a ferroelectric (FE) state at room temperature. The transition temperature T_C increases with the C/F ratio. The $B_{5.25}L_{0.75}F_{1-x}C_{1-x}O_{18}$ ceramics also exhibit a transition from a paramagnetic (PM) state to a ferromagnetic (FM) state at room temperature. The transition temperature T_M increases with the C/F ratio. The $B_{5.25}L_{0.75}F_{1-x}C_{1-x}O_{18}$ ceramics exhibit a transition from a paraelectric (PE) state to a ferroelectric (FE) state at room temperature. The transition temperature T_C increases with the C/F ratio. The $B_{5.25}L_{0.75}F_{1-x}C_{1-x}O_{18}$ ceramics also exhibit a transition from a paramagnetic (PM) state to a ferromagnetic (FM) state at room temperature. The transition temperature T_M increases with the C/F ratio.

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$B_{5.25}L_{0.75}F_1C_{1.5}O_{18}$
 (BLFC) L
 F, A, a, b ,
 BLFC a, b
 A
 N F
 A BLFC
 BLFC
 F 1
 A
 B2cb
 A
 A21
 B2cb
 $a = 5.4530(2) \text{ \AA}$, $b = 5.4427(1) \text{ \AA}$,
 $c = 50.670(2) \text{ \AA}$
 $b = 5.3943(6) \text{ \AA}$, $c = 41.487(2) \text{ \AA}$
 A21am
 $a = 5.4651(6) \text{ \AA}$,
 $b = 5.3943(6) \text{ \AA}$, $c = 41.487(2) \text{ \AA}$
 F

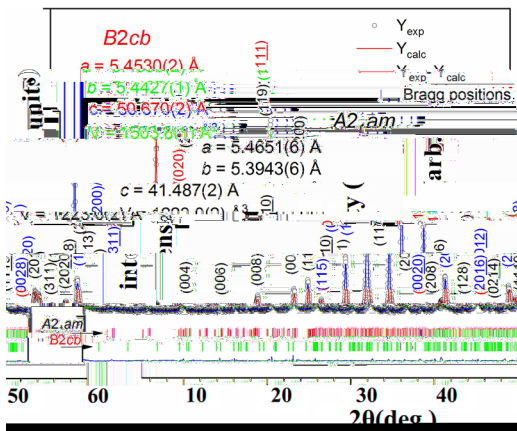


FIG. 1. XRD pattern of B2cb and A21am phases.

BLFC
 $= 4$, $= 5$, A, N
 BLFC F 1 EM (a-b) M
 F 1
 BLFC ED 1.4 %, (F 2
 1)
 F, C, O, C₂F₂O₄
 A B₅F_{0.5}C_{0.5}O₁₅¹⁶
 BLFC
 (50, 70 100,
 300, 500 H).
 1060 K
 FE T BLFC H
 BLFC
 (973 K).¹³ F 2() P-E I-E
 BLFC
 I-E
 BLFC 10 μC/ 2.
 F 2()
 (FC) (FC) 200 O BLFC BLFC

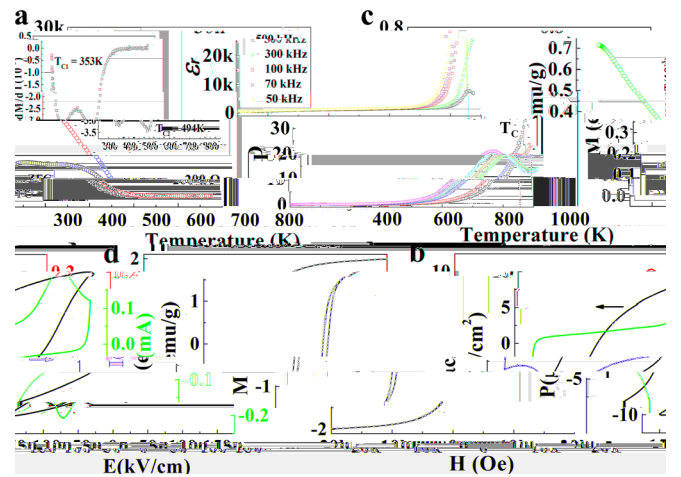


FIG. 2. Temperature dependence of the magnetic properties of BLFC. (a) dM/dT vs Temperature (K) for frequencies 300 kHz, 100 kHz, 70 kHz, and 50 kHz. (b) M vs Temperature (K) for the same frequencies. (c) M vs Temperature (K) for frequencies 30, 20, 10, and 5 kHz. (d) M vs E (kV/cm) for frequencies 30, 20, 10, and 5 kHz. (e) M vs H (Oe) for frequencies 30, 20, 10, and 5 kHz. Tc = 353K.

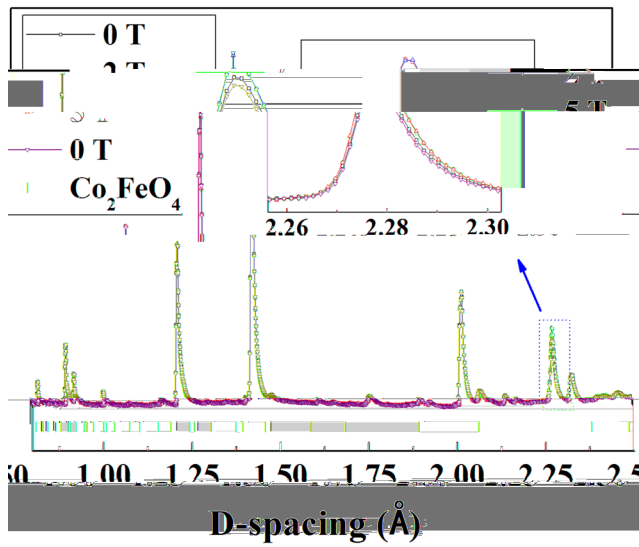


FIG. 4. XRD patterns of Co_2FeO_4 at 0 T (red) and 2 T (blue). The inset shows the zoomed-in view of the 2.25–2.30 Å region.

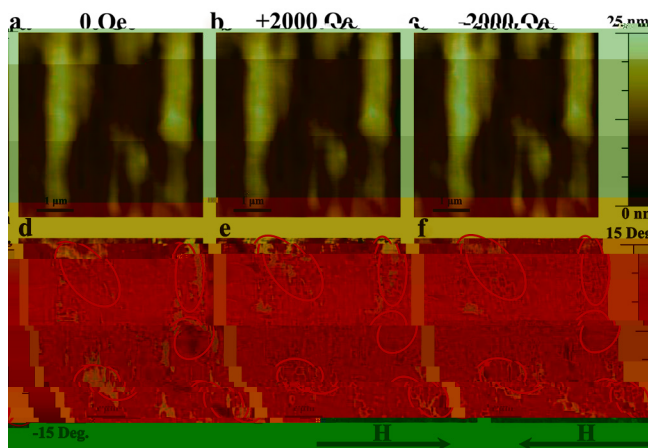
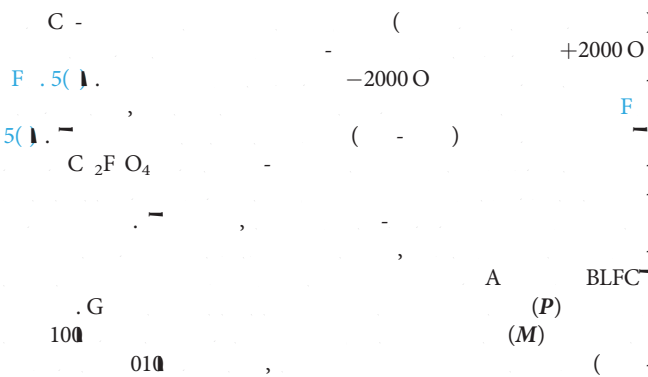


FIG. 5. MFM images of Co_2FeO_4 at 0 Oe (a, d), +2000 Oe (b, e), and -2000 Oe (c, f). The top row shows the original images, and the bottom row shows the corresponding phase images.

$T = P \times M$
 BLFC⁻
 I , A BLFC⁻
 F
 C³⁺ O C³⁺, F³⁺ O C³⁺ F³⁺ O F³⁺,
 A , C / F
 EM (ED) BLFC⁻
 D . M , D . K , D.
 D I H I I N , AL,
 D , O , K.
 A E D F
 G A A (G N . 2/
 0038/20), C (G N . K2015-0602006), N FC (G
 N . 11474138 11834005). A
 E M (EM)
 IND54 N EM
 EM E, AME E

DATA AVAILABILITY

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