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ABSTRACT

Multiferroic Aurivillius phase ceramics with the general formula $B_{5-x}F_xO_{15}$ ($x = 0, 0.25, 0.5, 0.75, 1$) were synthesized by a solid-state reaction method. The structure of the Aurivillius phase was confirmed by X-ray diffraction (XRD) and Rietveld refinement. The room-temperature magnetic and ferroelectric properties were investigated by magnetization and polarization-electric field ($P-E$) hysteresis loops, respectively. The results show that the Aurivillius phase ceramics exhibit room-temperature multiferroic behavior. The magnetic and ferroelectric properties of the Aurivillius phase ceramics are strongly dependent on the x value. The room-temperature magnetic and ferroelectric properties of the Aurivillius phase ceramics are strongly dependent on the x value. The room-temperature magnetic and ferroelectric properties of the Aurivillius phase ceramics are strongly dependent on the x value.

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~ 494 K
 $B_6FC_3O_{18}$ (526 K).²³
 BLFC
 $F^{3+} O F^{3+}, C_a^{3+} O C_a^{3+}, F^{3+} O C^{3+}$ (\dots).²⁴
 ~ 353 K
 $C_2F_2O_4$ (460 K)
 $(M) C_2F_2O_4$.^{16,25}
 $16.235 / \dots$
 $C_2F_2O_4$ $0.22, 0.32$ / ,
 $M = 1.85$ / , $F_a \cdot 2(\dots)$ I
 $M H$
 $2(F_a \cdot 3)$
 425 K 1.58 / 0.27 / ,
 ED
 BLFC
 $F_a \cdot 3$
 (DF) $F^{3+} O C^{3+}$ *ab initio*
 $(A P)$
 $F = 2$ $C = 3$ $F_a C_a$
 $(GGA) + I$
 $F \cdot 3(\dots)$ BLFC $F^{3+} C^{3+}$ $(3.1 \mu_B/a)$ $2.1 \mu_B/a$
 $0.1 \mu_B/a$
 $F O_6$ $C O_6$
 F/C $F \cdot 3(\dots)$
 $F_a O_a$ $F^{3+} C^{3+}$
 (\dots)
 $E_{FM} - E_{AFM}$
 $= -144.1$
 H_a 43.5 ($\dots, 504.6$ K), (FM) FM
 FC/FC $F \cdot 2(\dots)$ *ab*
 010
 $F_a \cdot 4$
 BLFC
 I

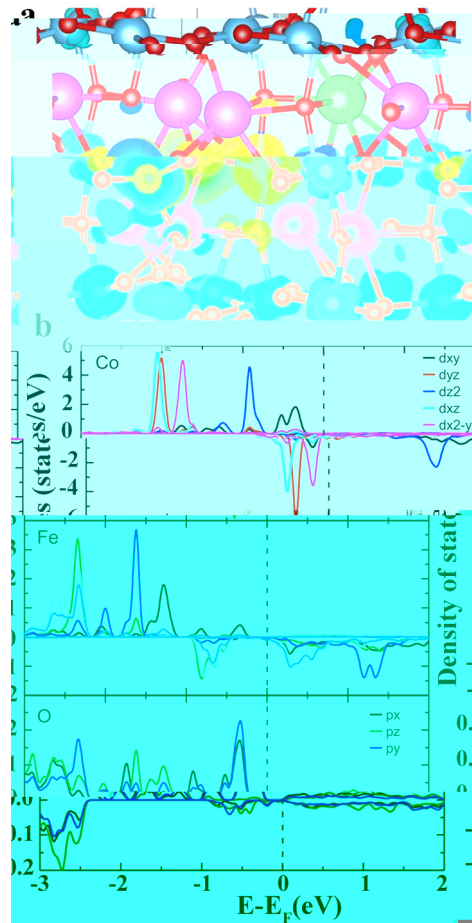


FIG. 3. (a) Crystal structure of BLFC. (b) Density of states (DOS) for BLFC. The DOS is calculated using the GGA+U method with $U = 0.005$ eV. The DOS is shown for Co, Fe, and O atoms. The energy axis is $E - E_F$ (eV) and the DOS axis is states/eV.

N
 I $F_a \cdot 4$ $(0, 1, 20)$
 $2 \leq H < 5$
 $M H$ $F_a \cdot 2(\dots)$ $3 F_a$
 $F_a \cdot 5$
 BLFC
 P F M
 $399 O$
 F
 $5(\dots) A$ PFM $BLFC$ P

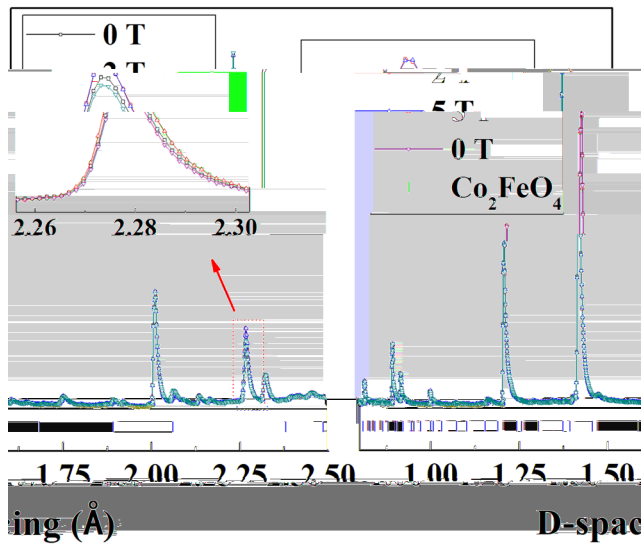


FIG. 4. XRD patterns of Co_2FeO_4 at 0 T and 5 T. The x-axis is labeled 'D-spacing (Å)'.

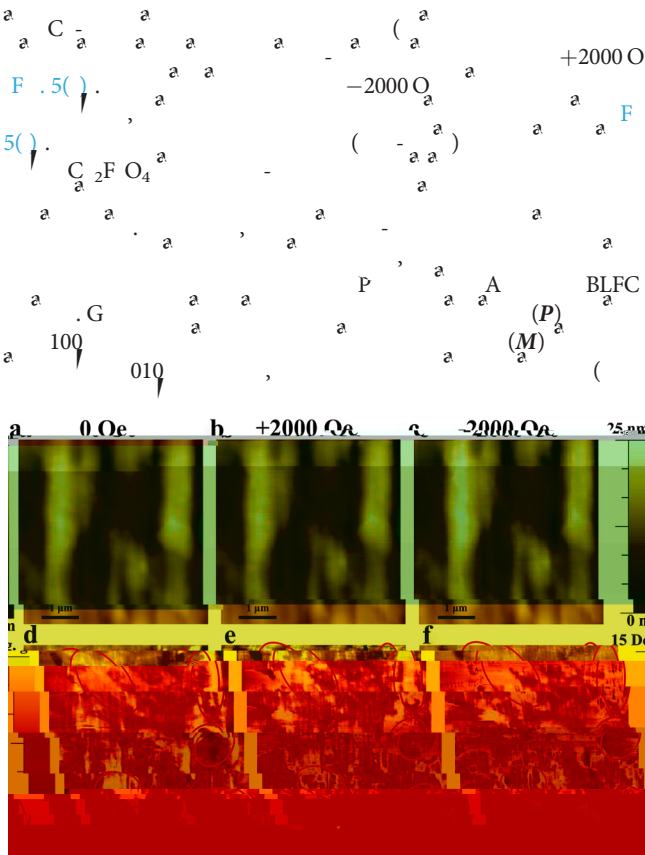


FIG. 5. MFM images of Co_2FeO_4 at 0 Oe, +2000 Oe, and -2000 Oe. The x-axis is labeled 'D-spacing (Å)'.

$T = P \times M$
 BLFC
 $\text{C}^{3+} \text{O}_2 \text{C}^{3+} \text{F}^{3+} \text{O}_2 \text{C}^{3+}$
 $\text{C}_2\text{F}_2\text{O}_4$
 EM (ED)
 BLFC
 D.M., P., D.K., D.
 I.H., I.I.N., AL.
 D., O., K.
 A.E., D.F., G.A., A.A., A.A., G.N., 2/0038/20, C.G., N.K2015-0602006, N.F.C. (G.N. 11474138, 11834005). A.P. (EM P IND54 N. EM P E AME E)

DATA AVAILABILITY

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