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Cite as: Appl. Phys. Lett. **117**, 052903 (2020); <https://doi.org/10.1063/5.0017781>

Submitted: 09 June 2020 . Accepted: 25 July 2020 . Published Online: 07 August 2020

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Submitted: 9 June 2020 · Accepted: 25 July 2020 ·

Published Online: 7 August 2020 · Corrected: 11 August 2020



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ABSTRACT

Multiferroic Aurivillius phase ceramics (APCs) exhibit a rich variety of magnetic and ferroelectric (FE) orders. However, the origin of the multiferroic behavior in these materials remains unclear. In this work, we study the multiferroic behavior in the Aurivillius phase ceramic $B_{5.25}L_{0.75}FeC_{18}O_{18}$ by using neutron diffraction and *in situ* x-ray diffraction. The magnetic structure is determined to be $F^{3+}O F^{3+}, C^{3+}O C^{3+}$, and the ferroelectric structure is $F^{3+}O C^{3+}$. The results show that the multiferroic behavior in this material is due to the presence of the $F^{3+}O C^{3+}$ structure, which is a common feature in all Aurivillius phase ceramics.

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Multiferroic Aurivillius phase ceramics (APCs) exhibit a rich variety of magnetic and ferroelectric (FE) orders. However, the origin of the multiferroic behavior in these materials remains unclear. In this work, we study the multiferroic behavior in the Aurivillius phase ceramic $B_{5.25}L_{0.75}FeC_{18}O_{18}$ by using neutron diffraction and *in situ* x-ray diffraction. The magnetic structure is determined to be $F^{3+}O F^{3+}, C^{3+}O C^{3+}$, and the ferroelectric structure is $F^{3+}O C^{3+}$. The results show that the multiferroic behavior in this material is due to the presence of the $F^{3+}O C^{3+}$ structure, which is a common feature in all Aurivillius phase ceramics.

~ 494 K
 $M/$),
 $B_6F C_3O_{18}$ (526 K).²³
 BLFC
 $F^{3+} O F^{3+}, C^{3+} O C^{3+}, F^{3+} O C^{3+}$ (.
 ED).²⁴
 A FC $2 \sim 353$ K
 $C_2F O_4$ 2 $16,25$
 $C_2F O_4$ (460 K) (M) $C_2F O_4$ 1.4 . %
 $16 \ 23.5$ / .²⁵ , $0.22 \ 0.32$ / ,
 $C_{2-} F O_4$ BLFC
 $M = 1.85$ / , $F . 2() . I$, $M H$
 $2 (F . 3)$ 1
 425 K 1.58 / . 0.27 / ,
 ED
 $BLFC$
 A
 $F 3$
 $F^{3+} O C^{3+}$
 (DF) $ab initio$
 $(A P)$ H
 $U_F = 2$ $U_C = 3$ $F C$,
 (GGA) I
 $BLFC$
 $F . 3()$, $F^{3+} C^{3+}$ (3.1 $2.1 \mu_B/$,) ,
 O
 $(0.1 \mu_B/)$.
 $F O_6 C O_6$ F/C -
 $()$ F O - / $F . 3()$.
 F $F^{3+} C^{3+}$ -
 $(. ,)$ $(. ,)$,
 $E_{FM} - E_{AFM}$
 $= -144.1$.
 H , (FM)
 43.5 (. , 504.6 K), FM -
 1 FC/FC $F . 2()$.
 $a b$
 010 .
 $BLFC$ $F 4$. I
 $399 O$.
 $F .$
 P $F M$
 $5() . A$ PFM $BLFC$, $F -$

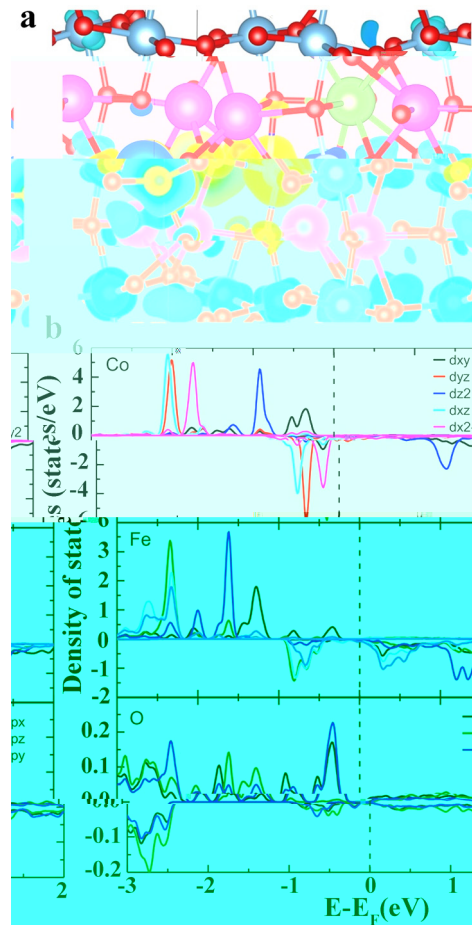


FIG. 3. (a) Crystal structure of BLFC (a = 0.38 nm, b = 0.38 nm, c = 0.005 nm), B (), a (), (), a (), a () A a . () A a

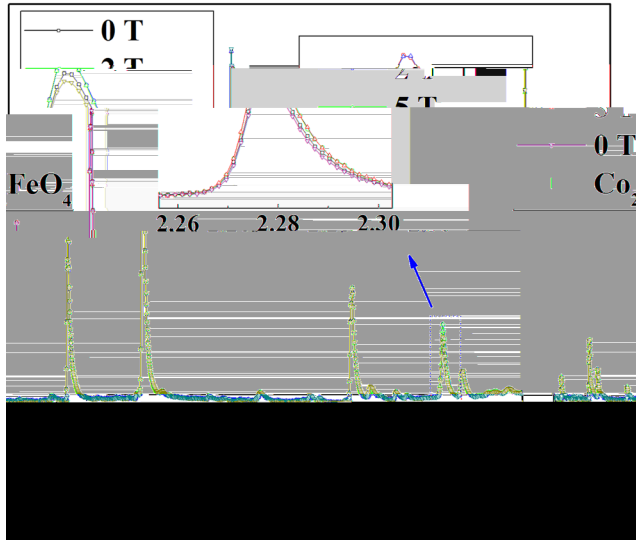


FIG. 4. XRD patterns of FeO₄ and Co₂ at 0 T, 2 T, and 5 T. The inset shows a magnified view of the 2.30 degree peak with a blue arrow pointing to a specific feature.

C - (+2000 O)
 F .5() . -2000 O
 5() . (-)
 C₂F O₄ - (-)
 P A BLFC
 .G (P)
 100 (M)
 010 (-)

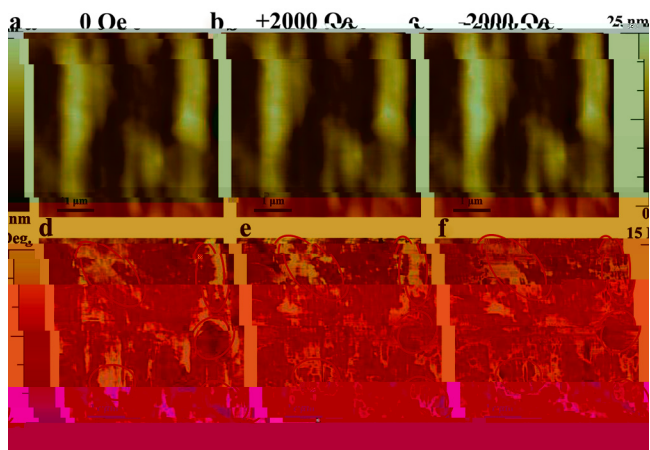


FIG. 5. MFM images of FeO₄ and Co₂ at 0 Oe, +2000 Oe, and -2000 Oe. The top row (a, b, c) shows the surface topography, and the bottom row (d, e, f) shows the magnetic contrast. Scale bars are 25 nm.

) $T = P \times M$
 BLFC
 I , A BLFC
 . F
 C³⁺ O C³⁺, F³⁺ O C³⁺ F³⁺ O F³⁺,
 . A , C /F
 EM - (ED)
 BLFC
 D . M , P 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 P (EM P)
 P IND54 N EM P
 EM P E PAME E

DATA AVAILABILITY

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