




# Room-temperature multiferroic behavior in layer-structured Aurivillius phase ceramics

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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$\sim 494$  K (M/),  
 $B_6FC_{3O_{18}}$  (526 K).<sup>23</sup>  
 BLFC  
 $F^{3+} O F^{3+}, C^{3+} O C^{3+}, F^{3+} O C^{3+}$  (.  
 ED).<sup>24</sup>  
 A ED  
 $FC$   $\sim 353$  K  
 $C_2F_2O_4$   
 $C_2F_2O_4$  (460 K)  $16.25$   
 (M)  $C_2F_2O_4$   $1.4$  %  
 $16.235$  /  $0.22$   $0.32$  /,  
 $C_2F_2O_4$  BLFC  
 $M = 1.85$  / ,  $F_2$  ( ) . I  
 $M H$   
 $2$  (  $F_2$  ) .  
 $425$  K  $1.58$  / .  
 $0.27$  / , ED  
 BLFC  
 $F_2$  3  
 $F^{3+} O C^{3+}$   
 (DF) *ab initio*  
 (A P)  
 $F = 2$   $C = 3$   $F$   $C$  ,  
 (GGA) . I  
 BLFC  
 $F_2$  3(a) ,  $F^{3+}$   $C^{3+}$  (  $3.1$   $2.1 \mu_B/a$  , ) ,  
 $0.1 \mu_B/a$  ) .  
 $F O_6$   $C O_6$   
 F / C  
 $F_2$  3 ( ) .  
 $F^{3+}$   $C^{3+}$   
 $E_{FM} - E_{AFM}$   
 $= -144.1$  .  
 H (FM)  
 $43.5$  (  $\dots$  ,  $504.6$  K ) , FM  
 $1$  FC/FC .  $F_2$  2 ( ) .  
*ab*  
 $010$   
 $F_2$  4  
 BLFC . I  
 $399$  O .  
 $F_2$  5 ( ) . A

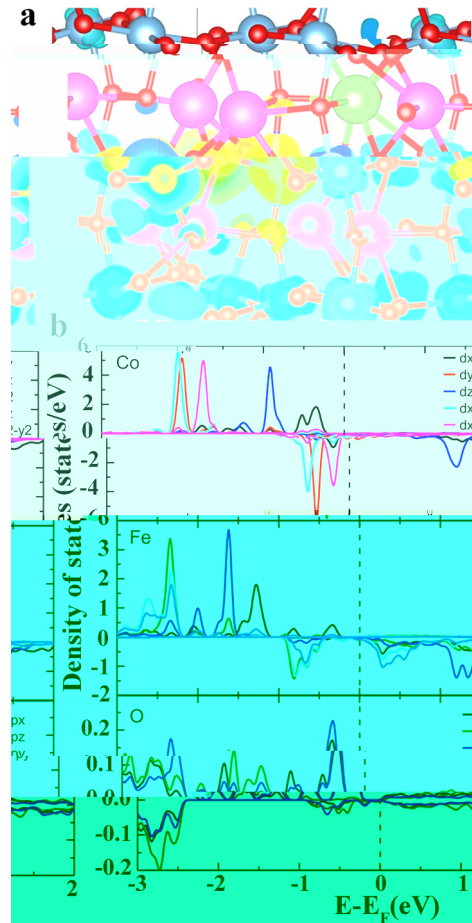


FIG. 3. (a) Crystal structure of BLFC. (b) Density of states (DOS) plots for Co, Fe, and O atoms. The Fermi level ( $E_F$ ) is indicated by a vertical dashed line at 0 eV.

BLFC  
 P F M  
 PFM  
 BLFC  
 A

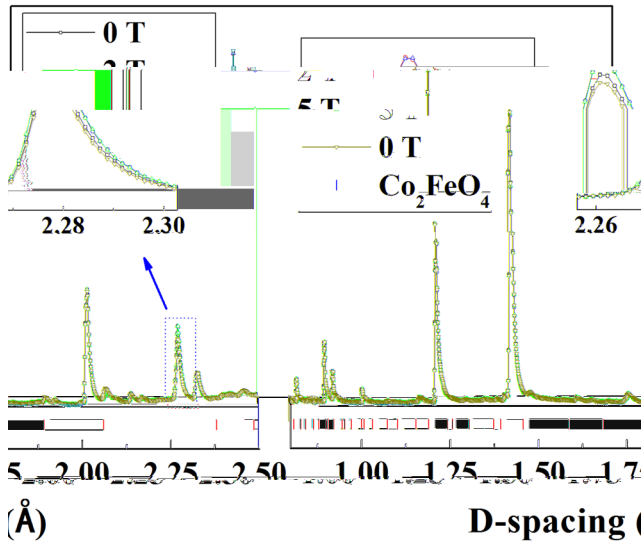


FIG. 4. XRD patterns of  $\text{Co}_2\text{FeO}_4$  at 0 T and 5 T. The inset shows the schematic of the sample and measurement setup.

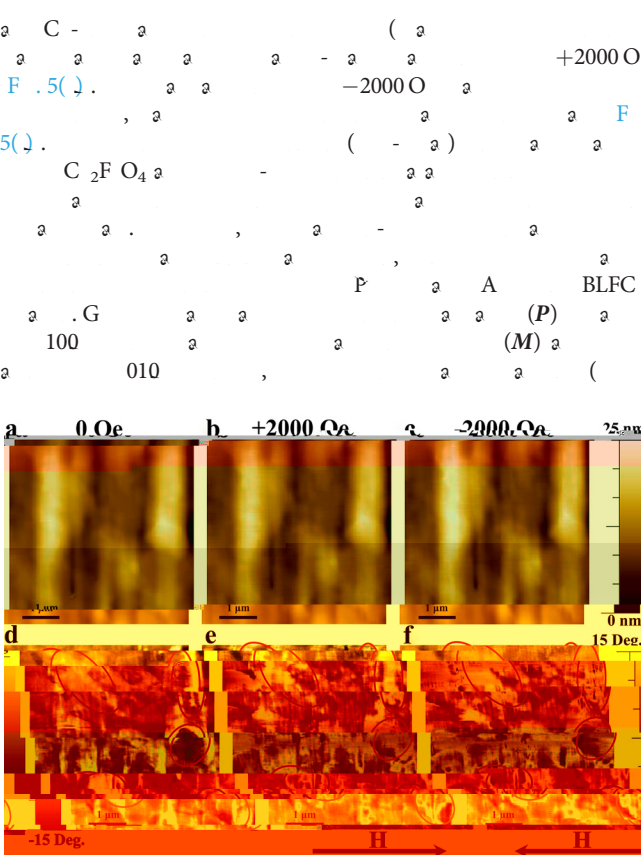


FIG. 5. MFM images of  $\text{Co}_2\text{FeO}_4$  at 0 Oe, +2000 Oe, and -2000 Oe. The images show magnetic domains and their evolution with increasing magnetic field. Scale bars are 1 μm and 25 nm. The bottom row shows a 15-degree rotated view of the domains.

$T = P \times M$   
 BLFC  
 $\text{C}^{3+} \text{O} \text{C}^{3+}, \text{F}^{3+} \text{O} \text{C}^{3+}$   
 $\text{A} \text{C} / \text{F}$   
 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, (G, N, 2/  
 0038/20), C (G, N, K2015-0602006), N FC (G,  
 N, 11474138, 11834005). A,  
 E, M, P (EM P)  
 P, IND54 Na, EM P  
 EM P, AME, E

DATA AVAILABILITY

The data that support the findings of this study are available in the article's supplementary material.

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