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Kun Tao,[7] Chenglong Jia,[7,a)] [redacted] Giuseppe Viola,[3] and Haixue Yan[3,b)]

AFFILIATIONS

[1] G f I , C f G f , 430074, C
[2] I f M , A , 47, K 04001,
[3] f E f M , M , f L , L E1 4N , K f E
[4] N K L D I f , C A f E ,
M 621900, C
[5] N L , H , 11 0L , K
[6] E f L , F , G 9 9 , K
[7] f , L , L 730000, C

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[b)] Author to whom correspondence should be addressed: @ .

ABSTRACT

M . H , - A
D . H , A $B_{5.25}La_{0.75}FC_3O_{18}$. A , *in situ*
F^{3+} O F^{3+}, C^{3+} O C^{3+}, F^{3+} O C^{3+} A , C /F

M (FM) (FE) H . A $B_5F_3O_{15}$ ($=4$) $B_6F_2\,{}_3O_{18}$ ($=5$), $B_4\,{}_3O_{12}$ B F O_3, FE FM .[12,13] B C F B- , $B_5F_{0.5}C_{0.5}\,{}_3O_{15}$ ($=4$) $B_6FC_3O_{18}$ ($=5$) .[1-4] H - .[5] , - A $(B_2O_2)^{2+}(A_{-1}B\,O_{3+1})^{2-}$ (A -, .[14,15] H , 12- , B - D)[6] .[16] , B- A B F O_3 - .[7-11]

I , A B 5.25La0.75F C 3O18 (BLFC) ( ). La C , [14,17] D F , A . A a b , BLFC a b . A [18] . A , in situ I H I I N AL, D , O , K. F ( ). , A BLFC BLFC . , .

F 1 - (D) BLFC . A B2cb - A , A2₁ , A [19,20] B2cb $a = 5.4530(2)$ A, $b = 5.4427(1)$ A, $c = 50.670(2)$ A - A2₁am $a = 5.4651(6)$ A, $b = 5.3943(6)$ A, $c = 41.487(2)$ A F (:// . .).

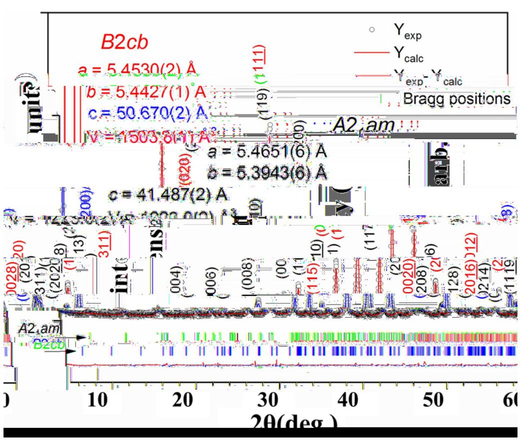

FIG. 1.

BLFC - A $= 4$ $= 5$. N D' . F 1 EM BLFC . - (a–b) . M , F . 1 . 1.4 . %, D. ED (F . 2 1) F , C , O, . , C 2F O4 . - A B 5F 0.5C 0.5 3O15.[16] F 2( ) BLFC (50, 70 100, 300, 500 H). 1060 K FE T BLFC . H , BLFC B 6 3F 2O18 (973 K).[13] F 2( ) P–E I–E BLFC . I–E [21,22] BLFC 10 µC/ 2. F 2( ) (FC) (FC) 200 O BLFC . BLFC

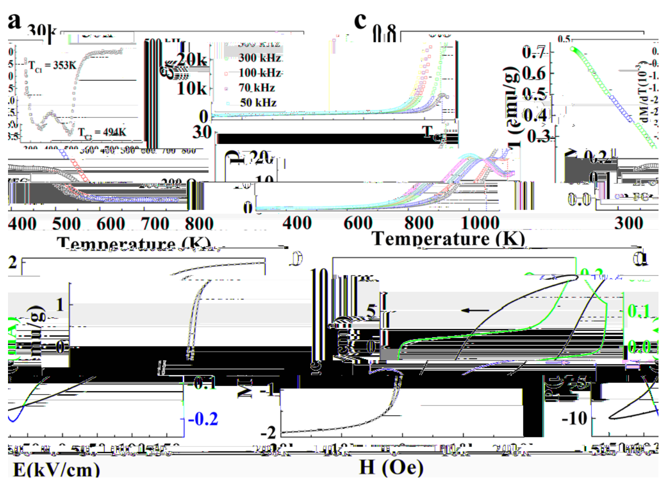

FIG. 2. ( ) ( ) ( ) . ( ) . ( ) $= 200$. M/ . ( ) t 300 .

$_1 \sim 494$ K (M/), B$_6$F C $_3$O$_{18}$ (526 K).[23] BLFC F^{3+} O F^{3+}, C^{3+} O C^{3+}, F^{3+} O C^{3+} (.).[24] ED A FC $_2 \sim 353$ K C$_2$F O$_4$. $_2$ C$_2$F O$_4$ (460 K) .[16,25] (M) C$_2$F O$_4$ 16 23.5 / .[25] , 1.4 . % C$_{2-}$ F O$_4$ 0.22 0.32 / , BLFC M = 1.85 / , F . 2( ). I M H $_1$ $_2$ (F . 3). 425 K 1.58 / . 0.27 / , ED . , BLFC A .

F 3 F^{3+} O C^{3+} (DF) *ab initio* (A) . H $U_F = 2$ $U_C = 3$ F C , (GGA) . I BLFC F . 3(a), F^{3+} C^{3+} (3.1 2.1 μ_B/), O (0.1 μ_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 .

F 4 BLFC . I - , - ,

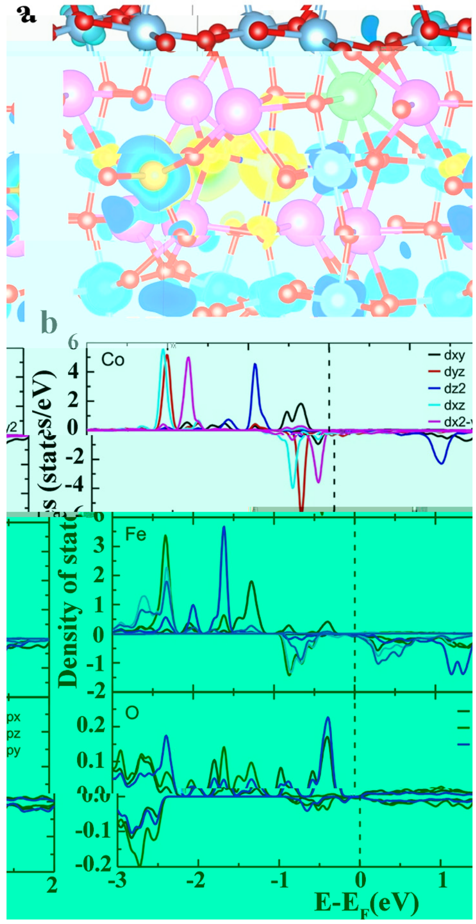

FIG. 3. ( ) = 0.005) ( ), ( ), ( ), ( ), ( ), ( ) . ( ) $^{3+}$ $^{3+}$.

. . N , , . I F . 4, A (0 1 20) . ' 2 . F (2 < H < 5), , 2 , M H F . 2( ) 3. F , .

F 5 BLFC F M 399 O . PFM BLFC , F . 5( ). A F -

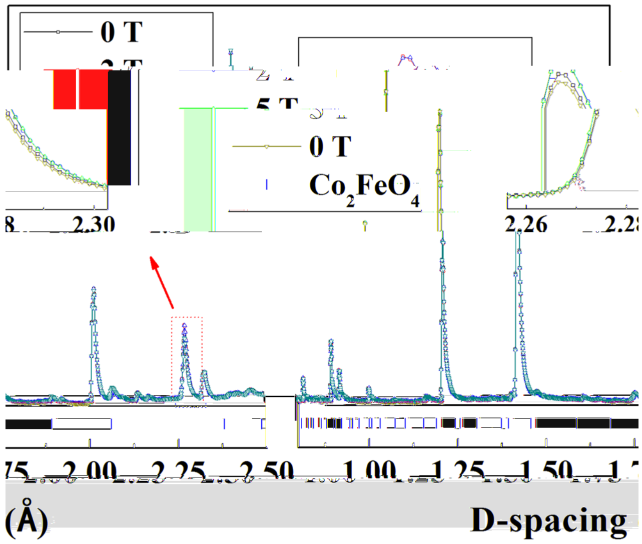

FIG. 4.

C - ( ) +2000 O F . 5( ). −2000 O F . 5( ). (-) C $_2$F O$_4$ BLFC . G (*P*) 100 (*M*) 010 , (-

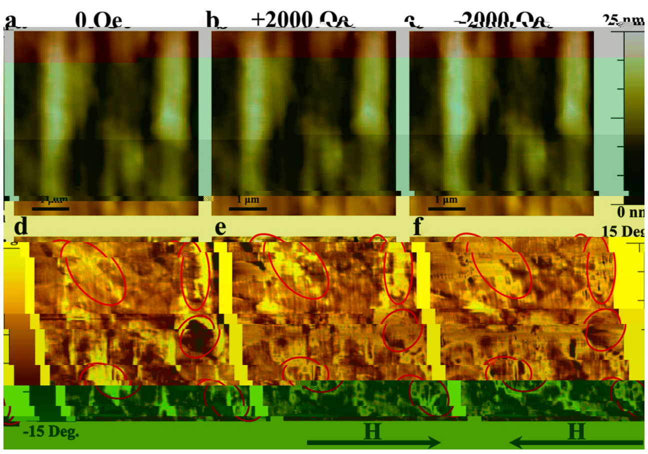

FIG. 5. +2000 −2000

) $T = P \times M$ BLFC . I , A BLFC . F F^{3+} O F^{3+}, C^{3+} O C^{3+}, F^{3+} O C^{3+} . 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 AME E .

DATA AVAILABILITY

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