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AFFILIATIONS

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

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ABSTRACT

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

M (FM) (FE) , . [1–4] H , . [5] $(B_2O_2)^{2+}(A_{n-1}B_nO_{3n+1})^{2-}$ (A , B 12- .)[6] B- BFO_3 . [7–11] A $B_5F_{}C_3O_{15}$ (= 4) $B_6F_2C_3O_{18}$ (= 5), $B_4C_3O_{12}$ BFO_3, FE FM . [12,13] B C F B- , $B_5F_{0.5}C_{0.5}C_3O_{15}$ (= 4) $B_6FC_3O_{18}$ (= 5) . [14,15] H , . [16] , D A .

I A B 5.25L 0.75F C $_3O_{18}$ (BLFC) P (P). P L

C , [14,17] D F , A

a b , P BLFC a b A

[18]

A in situ I H I I N AL, D O K. F

( ). A BLFC P

BLFC P .

, a a a

F 1 (D) BLFC . A B2cb A

A2$_1$ [19,20] A B2cb $a = 5.4530(2)$ A, $b = 5.4427(1)$ A, $c = 50.670(2)$ A $A2_1am$ $a = 5.4651(6)$ A, $b = 5.3943(6)$ A, $c = 41.487(2)$ A F P (:// . .).

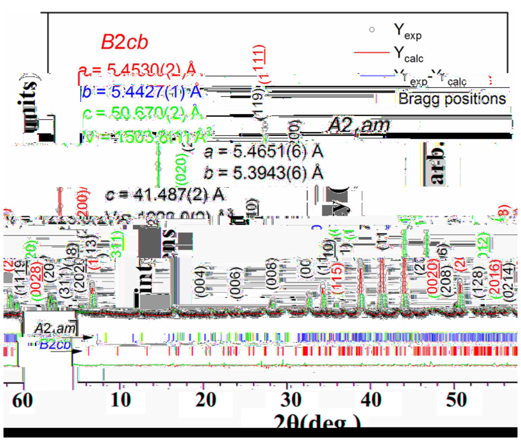

FIG. 1. - B .

BLFC A = 4 = 5 . N D' . F 1 EM BLFC (a–b) . P . M F . 1 1.4 . %, D. ED (F . 2 1) F , C , O, C $_2$F O$_4$ A B $_5$F $_{0.5}$C $_{0.5}$ $_3$O$_{15}$.[16] F 2( ) BLFC P (50, 70, 100, 300, 500 H). 1060 K FE T BLFC . H BLFC B $_6$ $_3$F $_2$O$_{18}$ (973 K).[13] F 2( ) P–E I–E BLFC P I–E [21,22] BLFC 10 μC/ ^{2}. F 2( ) (FC) (FC) 200 O BLFC . BLFC

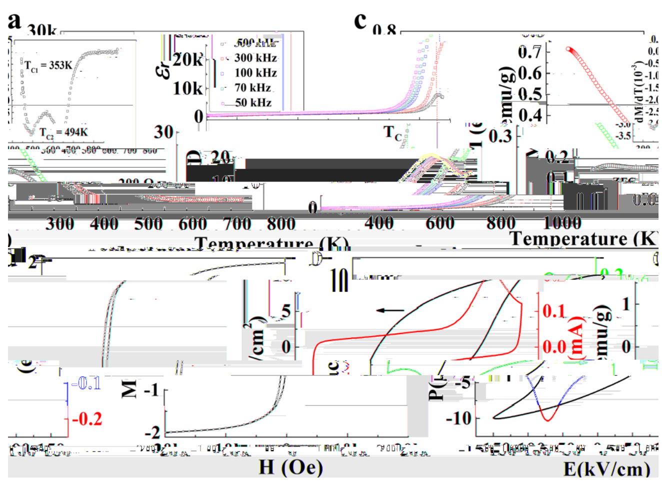

FIG. 2. ( ) ( ) ( ) B ⊥ P . ( ) P B P . ( ) B ⊥ / = 200 . M/ . ( ) 300 B .

a a a a a a a $_1$ ~ 494 K (a a a M/), a B $_6$F C $_3$O$_{18}$ (526 K).[23] a BLFC F $^{3+}$ O F $^{3+}$, C $^{3+}$ O C $^{3+}$, a F $^{3+}$ O C $^{3+}$ (.).[24] a a a a ED a A a a a a FC a $_2$ ~ 353 K a C $_2$F O$_4$. a a a a C $_2$F O$_4$ (460 K) a ^{2} a a [16,25] a (M) a C $_2$F O$_4$ 16 23.5 / .[25] , a 1.4 . % C $_{2-}$ F O$_4$ a 0.22 0.32 / , BLFC M = 1.85 / , F . 2( ). I a a a , M H a a a a $_2$ (F . 3). a a a a ^{1} a 425 K a 1.58 / a a a 0.27 / , a a a a ED a a BLFC a , A a a a . a a F 3 F $^{3+}$ O C $^{3+}$ a (DF) a a *ab initio* a (A P) . H a $_F$ = 2 a $_C$ = 3 F C , a a a a (GGA)+ . I a a BLFC F . 3( ), F $^{3+}$ C $^{3+}$ (3.1 2.1 μ_B/ ,), O (a 0.1 μ_B/). a a a a F O$_6$ C O$_6$ ( ) F /C a F a O / . F . 3( ). F a a F $^{3+}$ C $^{3+}$, a a (. ., a) a a a (. ., a) , a a a a a a a a E$_{FM}$ − E$_{AFM}$ = −144.1 . a a a a a H ' . (FM) a a 43.5 (. ., 504.6 K), FM a $_1$ a FC/FC a . F . 2( ). a a a *a b* a a a a a , 010 . F 4 a a a BLFC a a a a a I a a a a a a a a a , a a ,

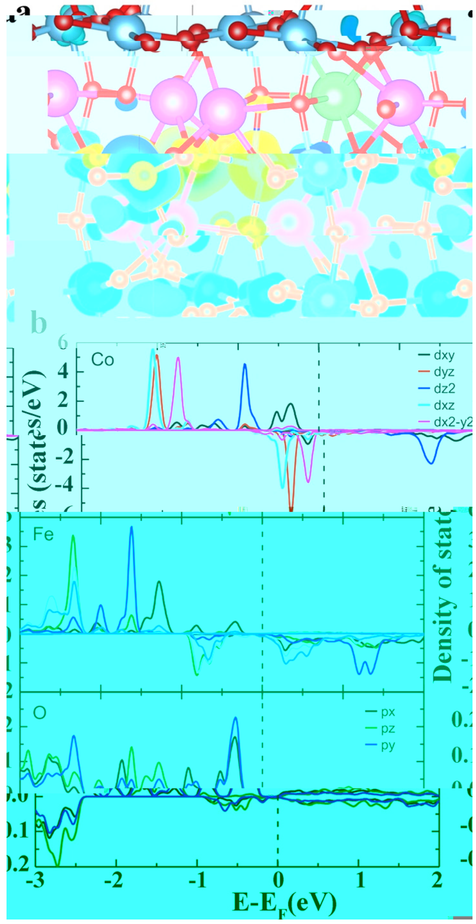

FIG. 3. ( ) (= 0.005) ( ), B ( ), ( ), ( ), (3+), 3+. ( ) . ( ) A

a . a a a a a . N a a a a a a a a , a a a a a a a a . I , F . 4, A a (0 1 20) a a , a a a 2 . F a (2 < H < 5), a a a a a , 2 , a a M H F . 2( ) 3. F a , a a a F 5 a BLFC a P F M a a a a a a a PFM a BLFC a , a 399 O . F . 5( ). A a a a F -

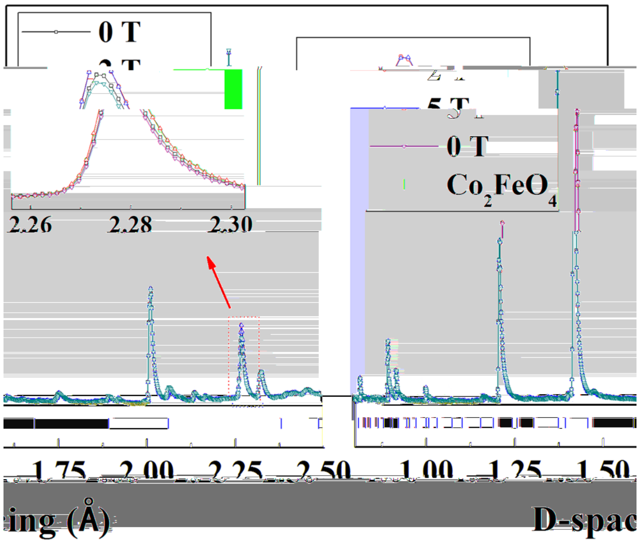

FIG. 4. - B (0, 2, 5 0).

a C - a a a a (a) a a a a - a a +2000 O F . 5( ) . a a −2000 O a - a a a F . 5( ) . (- a a) a a C $_2$F O_4 a - a - a a a - a a . a , a - a , a - P a A BLFC a . G a a a a (*P*) 100 (*M*) 010 , a (-

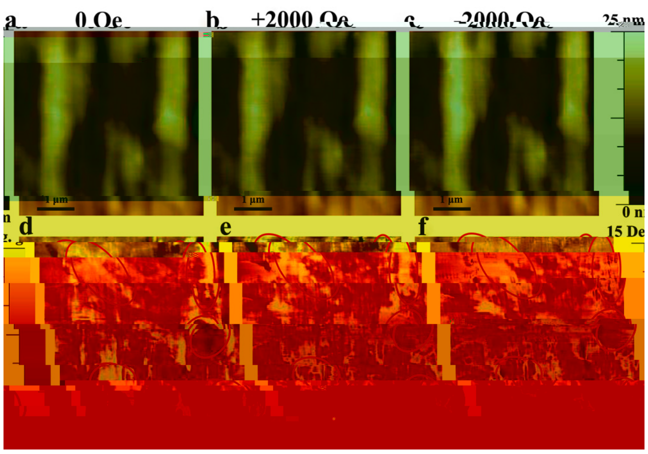

FIG. 5. B ( ). ( ) ( ) P M 0 ( ) ( ) P M +2000 ( ) ( ) P M −2000 .

) a $T = P \times M$ a a a a BLFC a I , a A a a a a BLFC a - a a . F a a a F 3+ O F 3+, C 3+ O C 3+, a F 3+ O C 3+ a a - a . a - a a . A a a a a a a , C /F a - , a a . a a a a a a a a a EM a a - (ED) a BLFC .

a a D . M a , P a a a D . K a a , D. D I H a I I N a a a , 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 a a E M P (EM P) P IND54 N . EM P EM P E AME E .

DATA AVAILABILITY

a a a a a a a a a a a a .

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