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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 99 , K
[7] , L , L 730000, C

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ABSTRACT

M . H , - A , - ... D . H , A $B_{5.25}L_{0.75}F\ C\ _3O_{18}$. - A , in situ . F^{3+} O F^{3+}, C^{3+} O C^{3+}, F^{3+} O C^{3+} - . - . A , C /F - , -

M (FE) (FM) , , .[1 4] H , - - .[5] , - A $(B_2O_2)^{2+}(A_{-1}B\ O_{3+1})^{2-}$ (A -, 12- - , B - - ,)[6] B- - B F O_3 - .[7 11] .

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) $B_6F\ C\ _3O_{18}$ (= 5) - .[14,15] H , D - .[16] , - A

I , A B $_{5.25}$L $_{0.75}$F C $_{3}$O$_{18}$ (BLFC) ( ). L , C , F , .[14,17] D 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 , *A2*$_1$, - A .[19,20] *B2cb* a = 5.4530(2) A, b = 5.4427(1) A, c = 50.670(2) A - *A2*$_1$*am* a = 5.4651(6) A, b = 5.3943(6) A, c = 41.487(2) A F (:// . .).

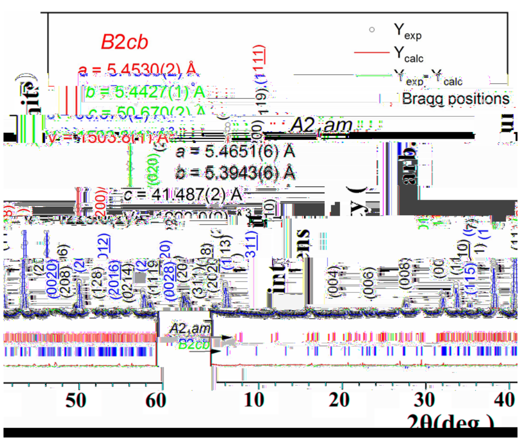

FIG. 1. - B .

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 $_2$F O$_4$. - A B $_5$F $_{0.5}$C $_{0.5}$ $_3$O$_{15}$.[16] F 2( ) BLFC (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 . I–E ,[21,22] . BLFC 10 μC/ ^{2}. F 2( ) (FC) - (FC) 200 O BLFC. BLFC

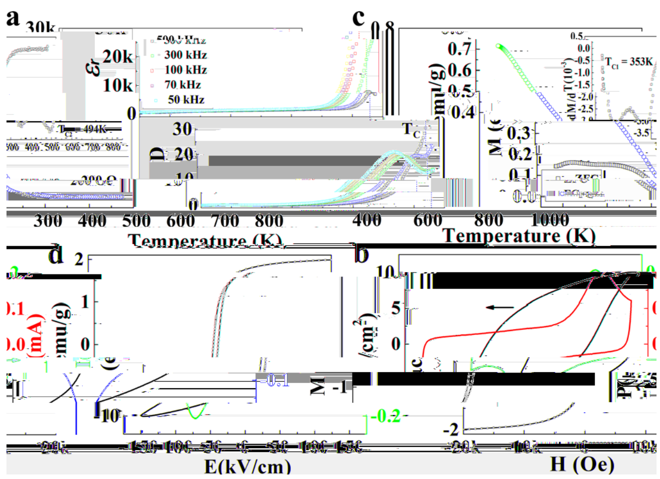

FIG. 2. ( ) ( ) ( ) B ⊥ P . ( ) P B P . . ( ) B ⊥ / = 200 . - M/ . ( ) - 300 B .

$_1$ ~ 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 $_2$ ~ 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
$_F$ = 2 $_C$ = 3 F C , ,
(GGA)+ . I -
BLFC
F . 3( ), 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
- , - ,

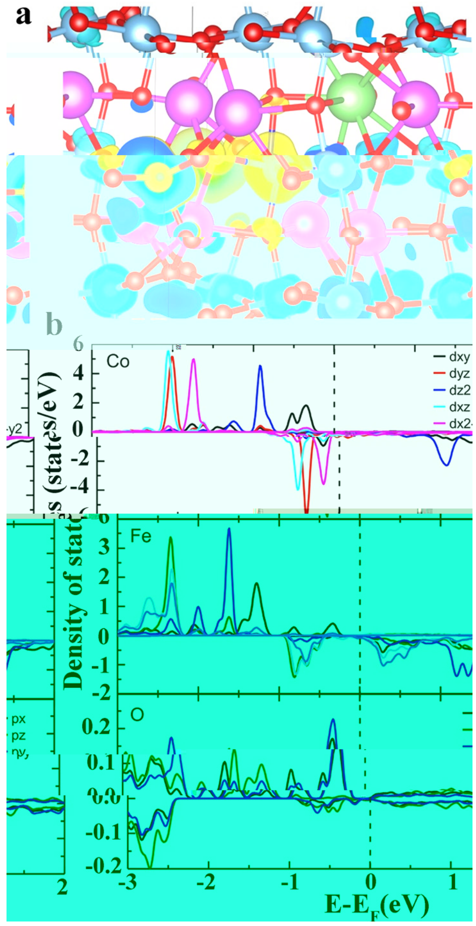

FIG. 3. ( ) (= 0.005) ( ), B ( ), ( ), ( ), ($^{3+}$), $^{3+}$. ( ) . ( ) A

.
. 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 .
FM BLFC , F .
5( ). A F -

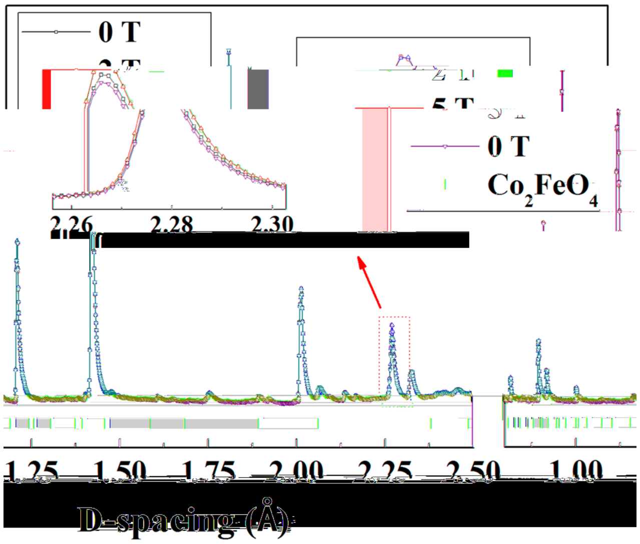

FIG. 4. - B (0, 2, 5 0).

C - ( ) +2000 O F . 5( ). −2000 O , F . 5( ). (-) C_2FO_4 - - - . , - , - , A BLFC . G (*P*) 100 (*M*) 010 , (-

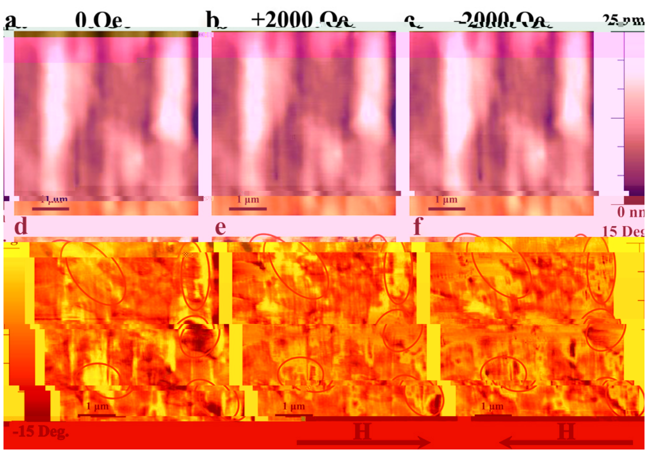

FIG. 5. B ( ). ( ) ( ) P M 0 ( ) ( ) P M +2000 ( ) ( ) P M −2000 .

) $T = P \times M$ 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 E AME E .

DATA AVAILABILITY

.

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