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Integration of single-crystalline nanocolumns into highly ordered nanopore arrays

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Abstract

(A). A

1. Introduction

1 . 2 , 3, 4 , 5, 6 , 7 , 8 ,

(A,) 9 11 , 12, 13 . B 14 15 . (2) ( ) (A). ( ). A (2 3) ~3.6 16 18 . 2 3

[1] A

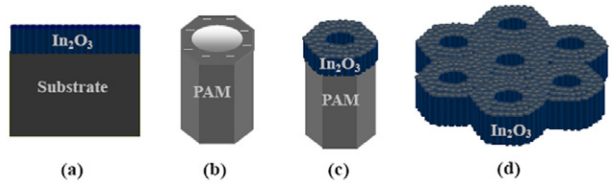

Figure 1. ( ) , ( ) , ( ) , ( ) , ( ) ( )

A $_2$ $_3$ [19, 20], [21, 22], [23], [24], [25], [26] [27]. 2 $_2$ $_3$. 2 [28] [29], [28] (, ,) (A $_2$ $_3$ [28], $_2$ [28], [30], [31], $_2$ $_3$ [32]) T/T (T T). 1( ), [33, 34]. 1( ) (C_2 $^{2-}_{4}$ $^{-}$) [35, 36]. 1( ). (1( )) .

2. Experimental details

[33], (100) [34],

30 90 100 0.1 [33, 34]. C $_4$ [34]. ~170 ~350 A 0.5 140 0 °C A 60 13.56 (90 % 10 % $_2$ 99.99%), 99.999% 1×10^{-3} 2.6 . 180 °C 180 °C 0.5 ~3 $^{-1}$. A ,

3. Results and discussion

(- 30) (2( )) ~15 - (2( )), ~50 . (-2100) (2( )) (2( )), ~5 (2( ) ( )). $_2$ $_3$(222) 0.290 2( ). $_2$ $_3$, (222) [27].

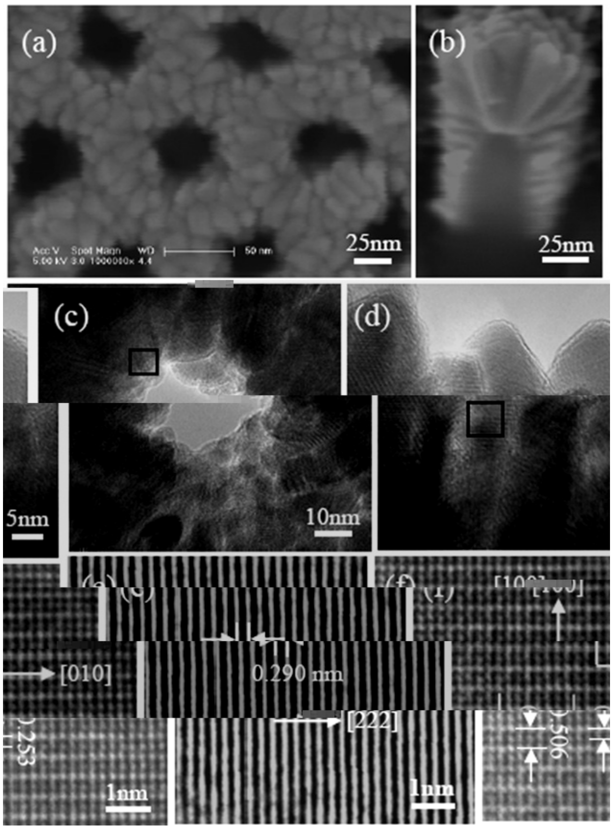

Figure 2. ( ) ( ) - - ; ( ) ; ( ) ; ( ) ( ) (222) 0.290 ; ( ) ( ) 100 .

(2( )) 0.506 (200) 0.253 (400). 100 010 , (222) 100 222 , 100 21, 22 , 24 , 25 ,

2 - . 33 , 3( ) - , - , . ., . (3( )) ~50

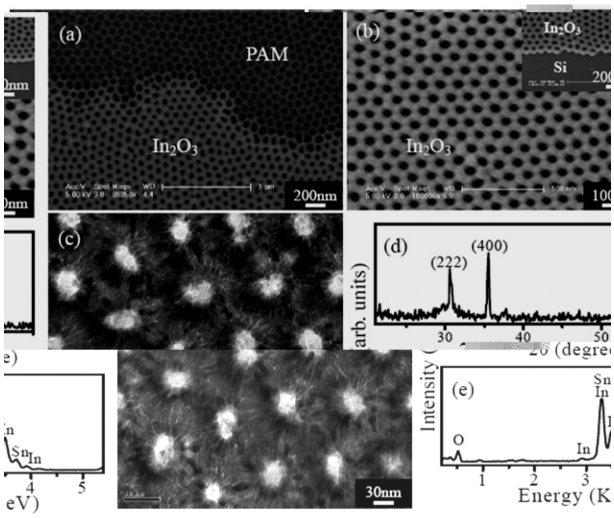

Figure 3. ( ) - ; ( ) - - - ; ( ) , ( ) , ( ) .

~100 , 2 , 33 . , , 3( ). (3( )) ~10 . - 2 - , 1.

2 - (B 8 A C) ( ). 3( ) (222) (400) $_2$ $_3$ $_2$ $_3$ ( ) , 1.012 32 . (400), $_2$ $_3$ (222) (400) 35 (C . 44-1087). - (222) 100 (3( )) , . ., 12:1. B - $_2$ $_3$. ~4×10^{-4} Ω , 2 .

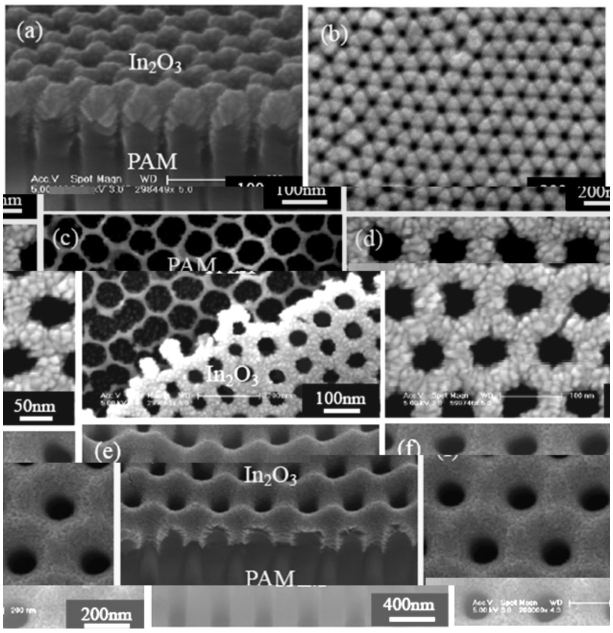

Figure 4. ( ) C - ( ) - ~30 ; ( ) ( ) ~90 ; ( ) - ( ) ~170 .

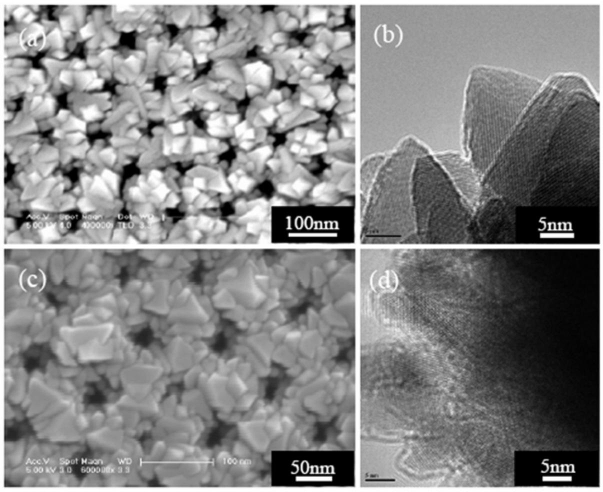

Figure 5. ( ) - ( ) 250 °C 0.5 ; ( ) - ( ) 180 °C 1.0 .

2 … 33 . 4 … ~30 … ~100 (40 0.1), - - 4( ) … (4( )) … ~25 … ~100 . (40 0.1). ~90 5 % 60 , 4( ), (~60) (4( )). (~10) … (., ~170 ~350 140 0.5), (~140) (~350) (4( ) ( )). (., 4( ) ( )), … - -

… 2 … 2 … 5( ) … 2 3, 250 °C. … 20 , 5( ). B … 30, 31 . - ~25 … (2( )). … 2 5( ). … 30, 31 , … 37 . … 0.3 5.0 … 29 32 . … 5( ) ( ) - … 180 °C 1.0 .

(5( )) (5( )). 2

4. Conclusions

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100

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A ( ) ( ), 2

2

(100%)

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1,

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Acknowledgments

C 10125416, 50572064, 03 14003, 05 14003, C (C).

References

1 C, C 2005 *Nature* **434** 1085
2 C A A, C 2000 *Appl. Phys. Lett.* **77** 666
3 C 2003 *Nature* **422** 599
4 C 2004 *Nano Lett.* **4** 423
5 A, 2004 *Nat. Mater.* **3** 380
6 B