FIG. 1

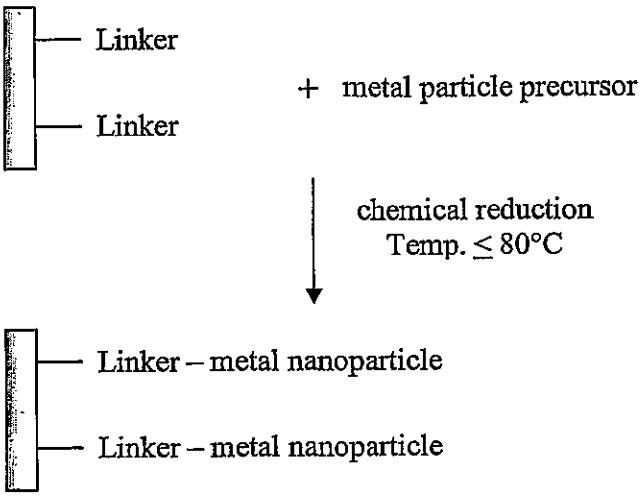

Linker
Linker
+ metal particle precursor
chemical reduction
Temp. ≤ 80°C
Linker – metal nanoparticle
Linker – metal nanoparticle

FIG. 2

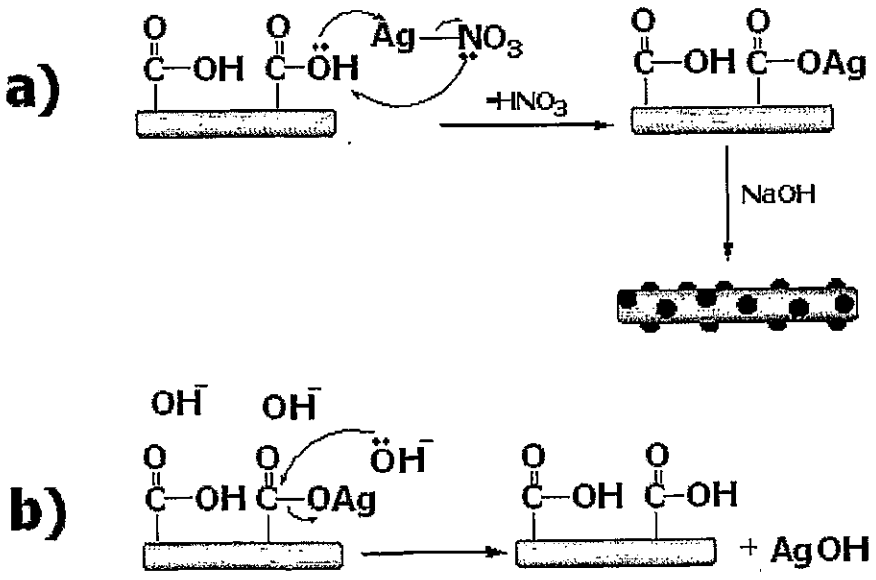

a)
Ag—NO3
+HNO3
NaOH
b)
OH⁻ OH⁻
+ AgOH

FIG. 3

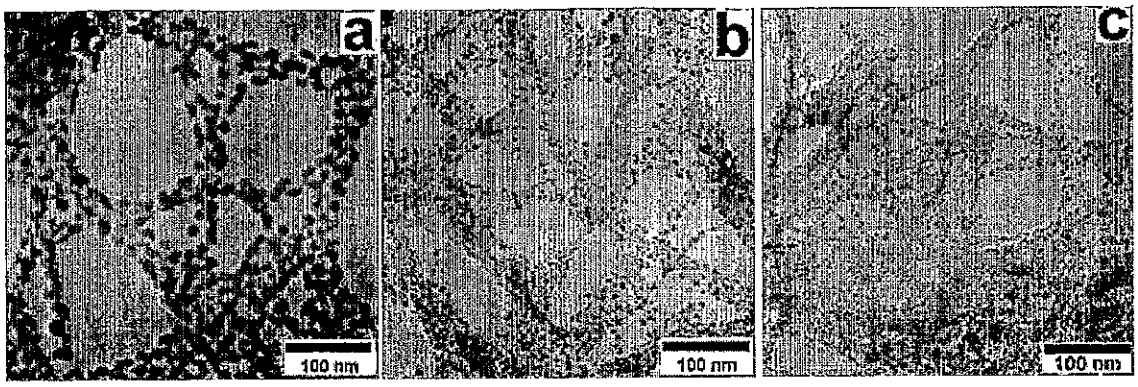

a
b
c
100 nm
100 nm
100 nm

FIG. 4

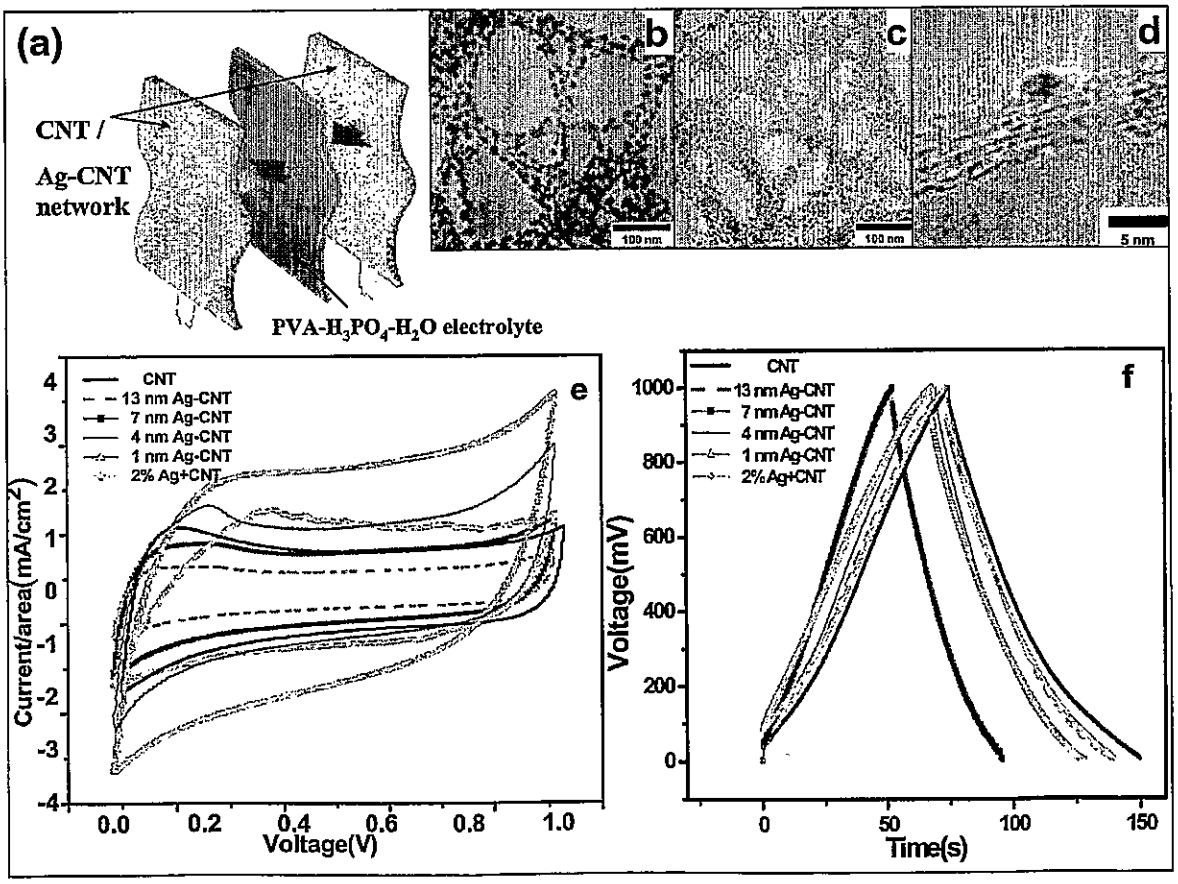

(a)
CNT /
Ag-CNT
network
PVA-H3PO4-H2O electrolyte
b
c
d
100 nm
100 nm
5 nm
e
CNT
13 nm Ag-CNT
7 nm Ag-CNT
4 nm Ag-CNT
1 nm Ag-CNT
2% Ag+CNT
Current/area(mA/cm2)
Voltage(V)
f
Voltage(mV)
Time(s)

FIG. 5



FIG. 6



FIG. 7

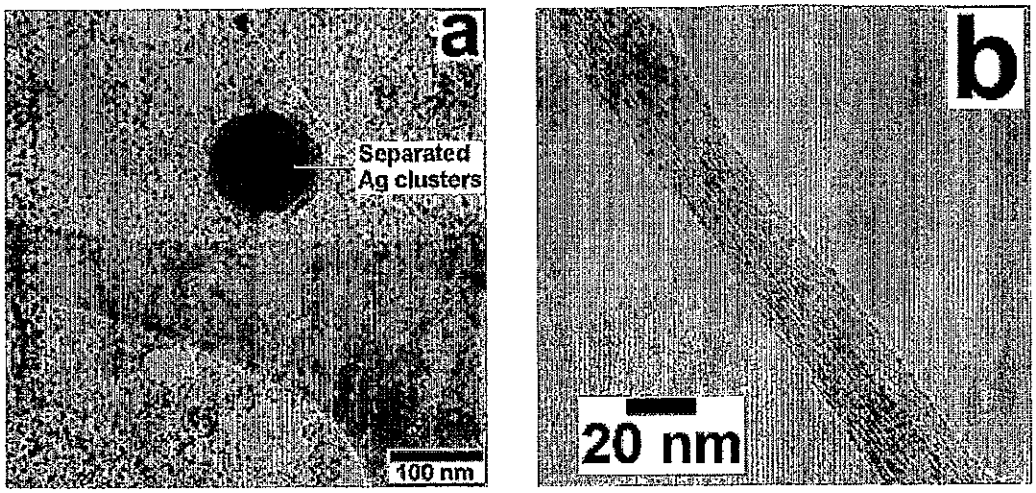

a
Separated
Ag clusters
100 nm
b
20 nm

FIG. 8

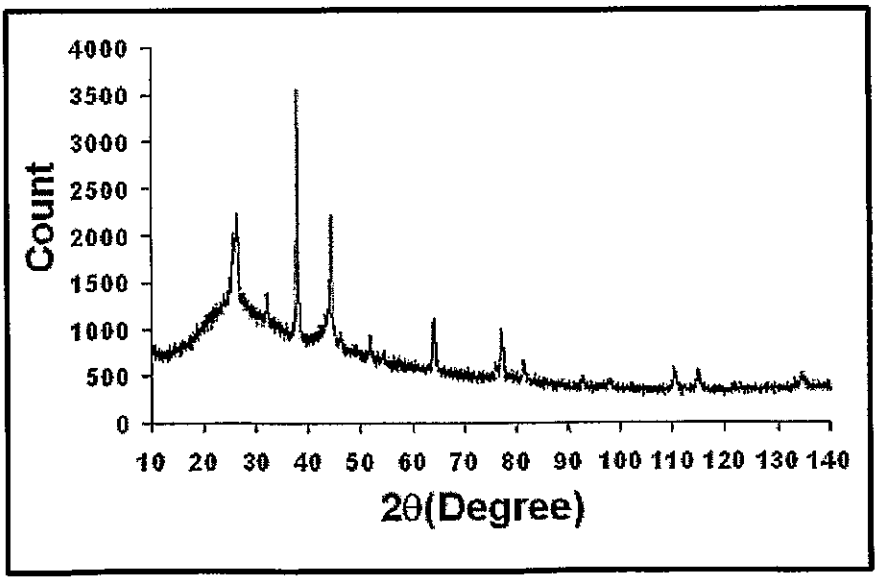

Count
4000
3500
3000
2500
2000
1500
1000
500
0
10 20 30 40 50 60 70 80 90 100 110 120 130 140
2θ(Degree)

FIG. 9

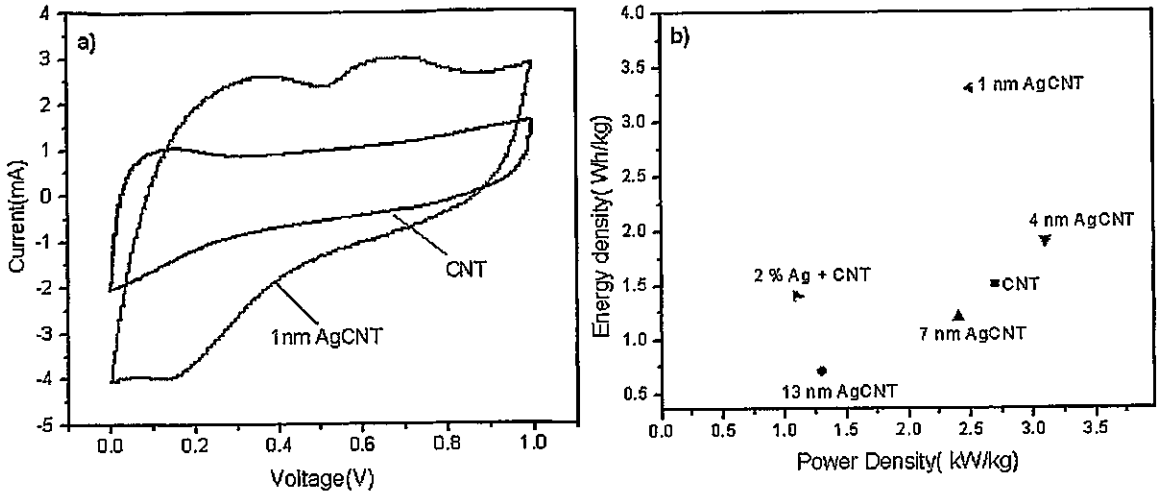

a)
Current(mA)
Voltage(V)
CNT
1nm AgCNT
b)
Energy density(Wh/kg)
Power Density(kW/kg)
1 nm AgCNT
4 nm AgCNT
2 % Ag + CNT
CNT
7 nm AgCNT
13 nm AgCNT

FIG. 10

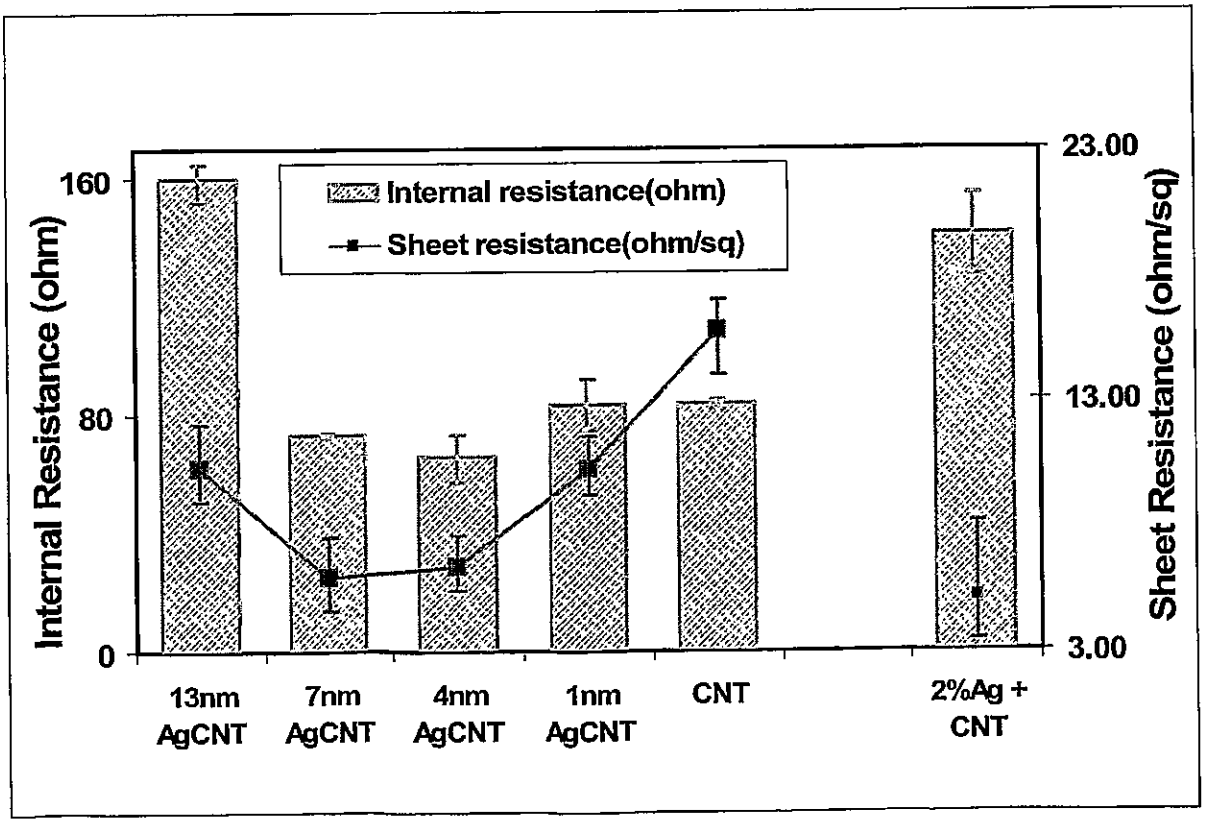
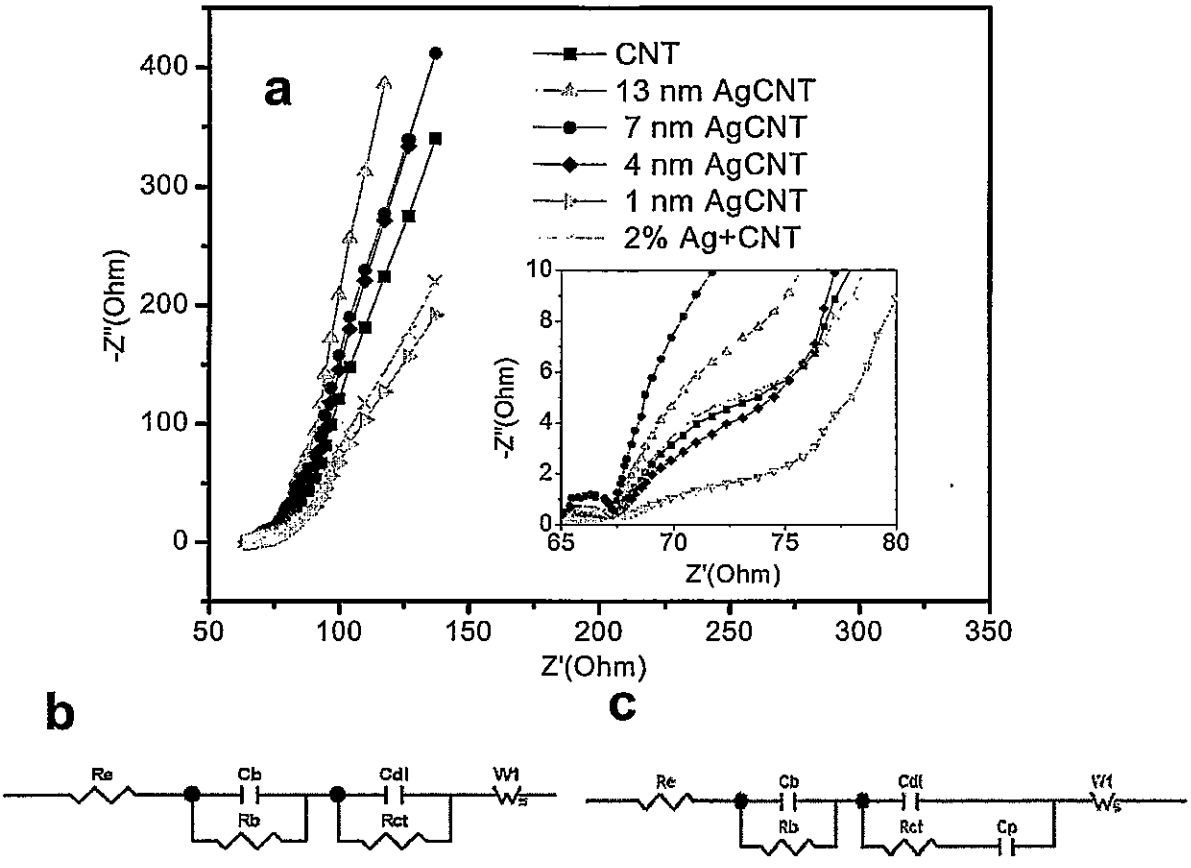
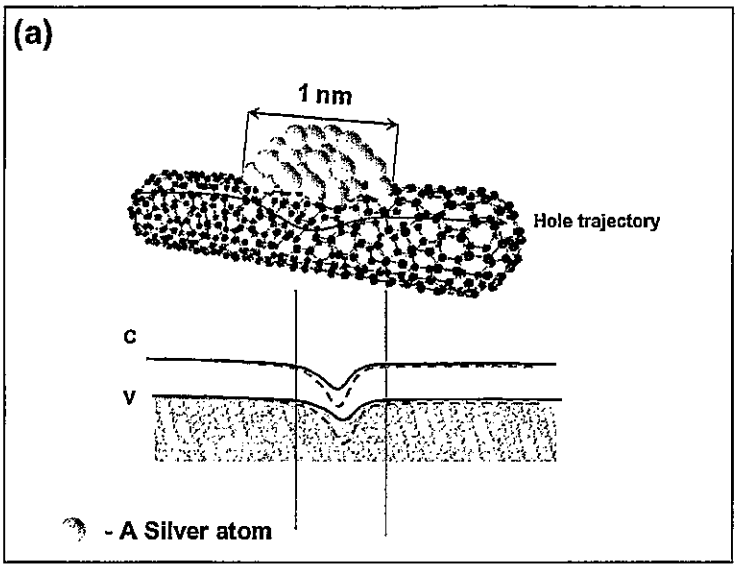

Internal resistance(ohm)
Sheet resistance(ohm/sq)
Internal Resistance (ohm)
Sheet Resistance (ohm/sq)
160
80
0
23.00
13.00
3.00
13nm AgCNT
7nm AgCNT
4nm AgCNT
1nm AgCNT
CNT
2%Ag + CNT

FIG. 11


a
CNT
13 nm AgCNT
7 nm AgCNT
4 nm AgCNT
1 nm AgCNT
2% Ag+CNT
-Z''(Ohm)
Z'(Ohm)
400
300
200
100
0
50
100
150
200
250
300
350
10
8
6
4
2
0
65
70
75
80

b
c
Re
Cb
Cdl
W1
Rb
Rct
Cp

FIG. 12


(a)
1 nm
Hole trajectory
C
V
- A Silver atom

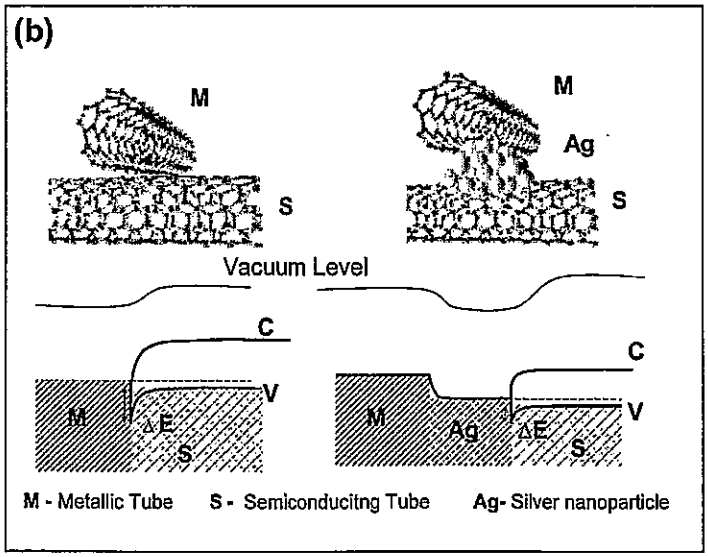

(b)
M
S
M
Ag
S
Vacuum Level
C
V
M
ΔE
S
C
V
M
Ag
ΔE
S
M - Metallic Tube
S - Semiconducitng Tube
Ag- Silver nanoparticle

FIG. 13



FIG. 14

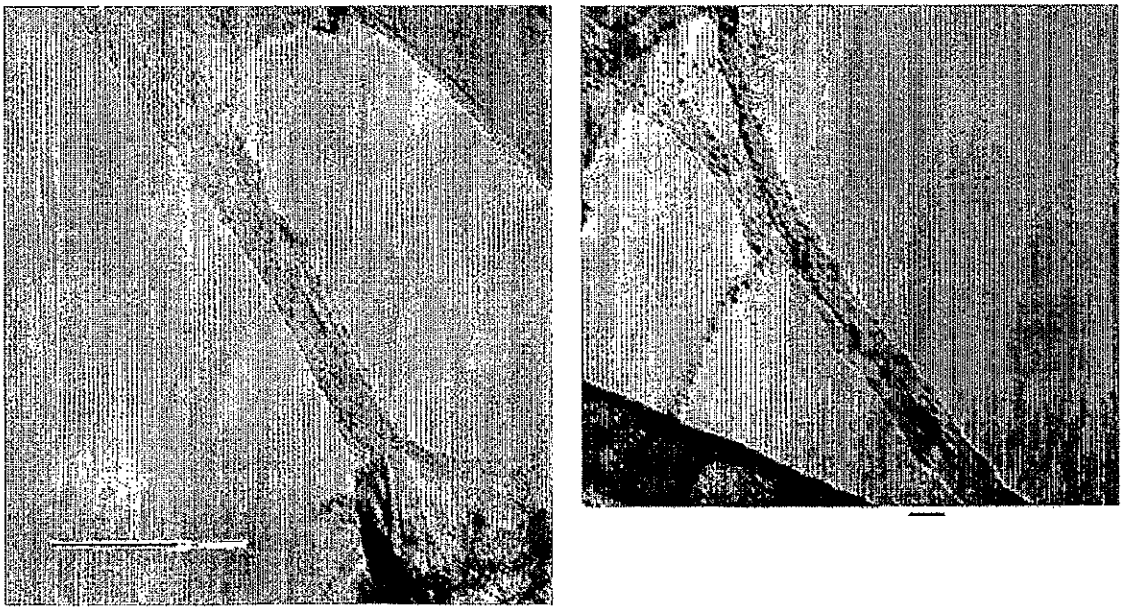


FIG. 15

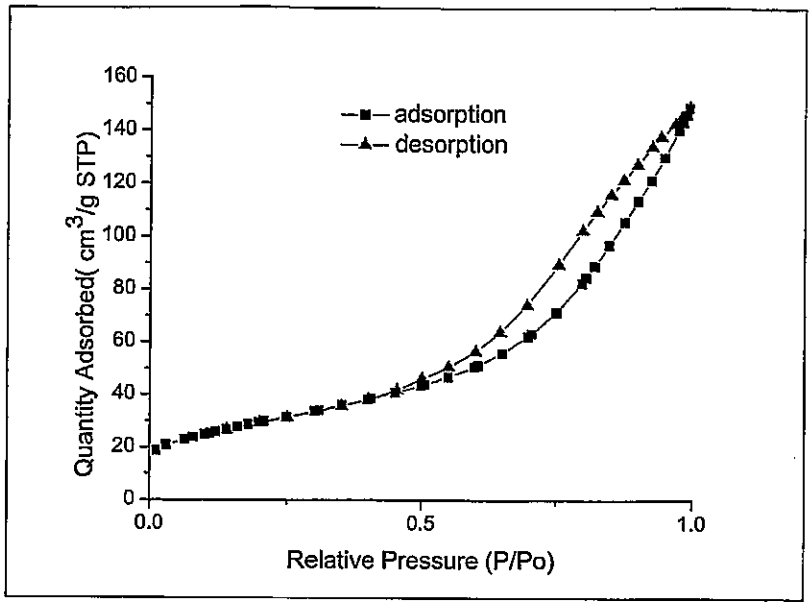

adsorption
desorption
Quantity Adsorbed(cm3/g STP)
Relative Pressure (P/Po)
0
20
40
60
80
100
120
140
160
0.0
0.5
1.0

FIG. 16

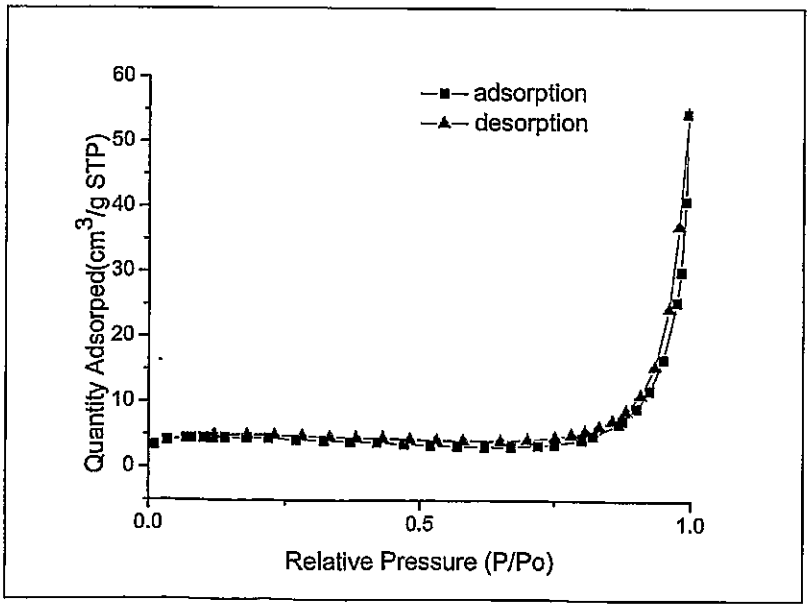

adsorption
desorption
Quantity Adsorped(cm3/g STP)
Relative Pressure (P/Po)
0
10
20
30
40
50
60
0.0
0.5
1.0

FIG. 17

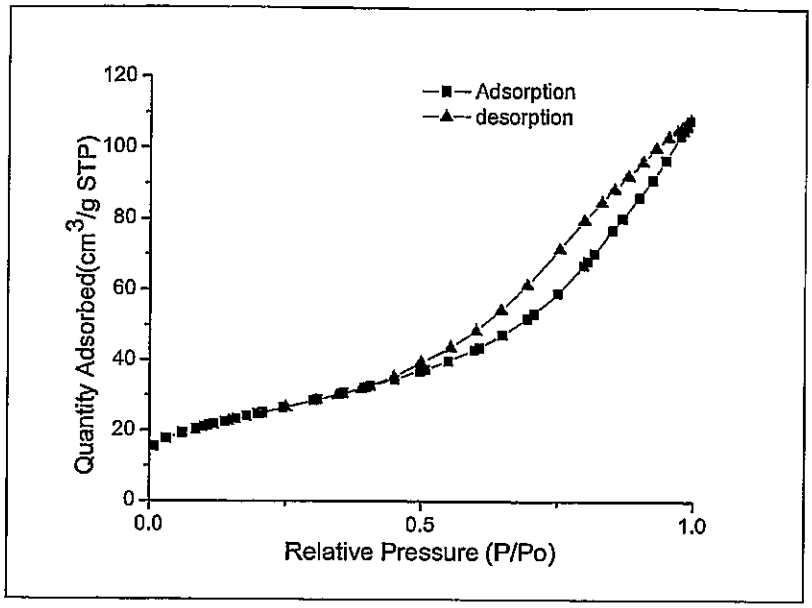

Adsorption
desorption
Quantity Adsorbed(cm3/g STP)
120
100
80
60
40
20
0
0.0
0.5
1.0
Relative Pressure (P/Po)

FIG. 18

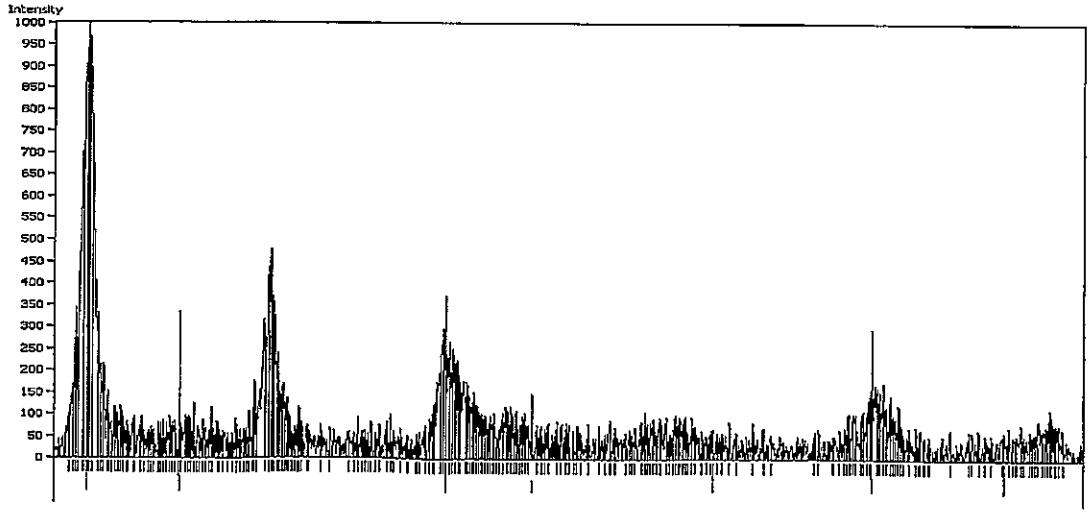

Intensity
1000
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0

FIG. 19

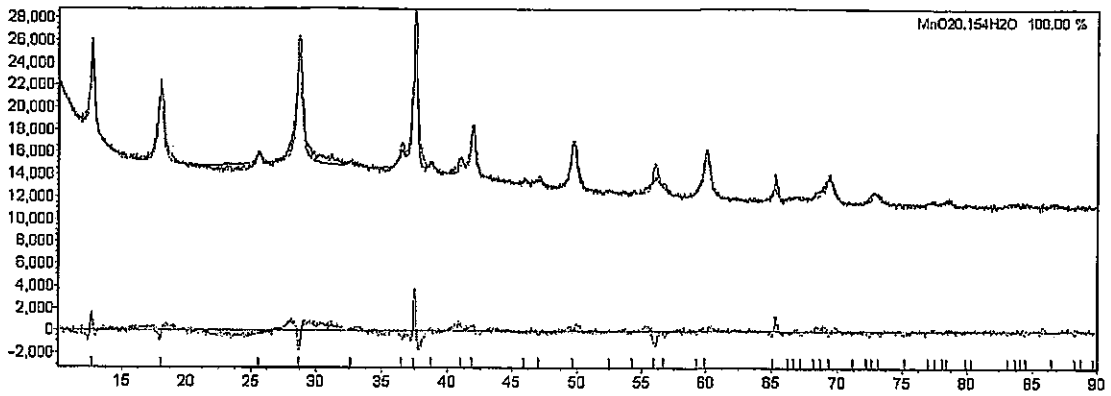
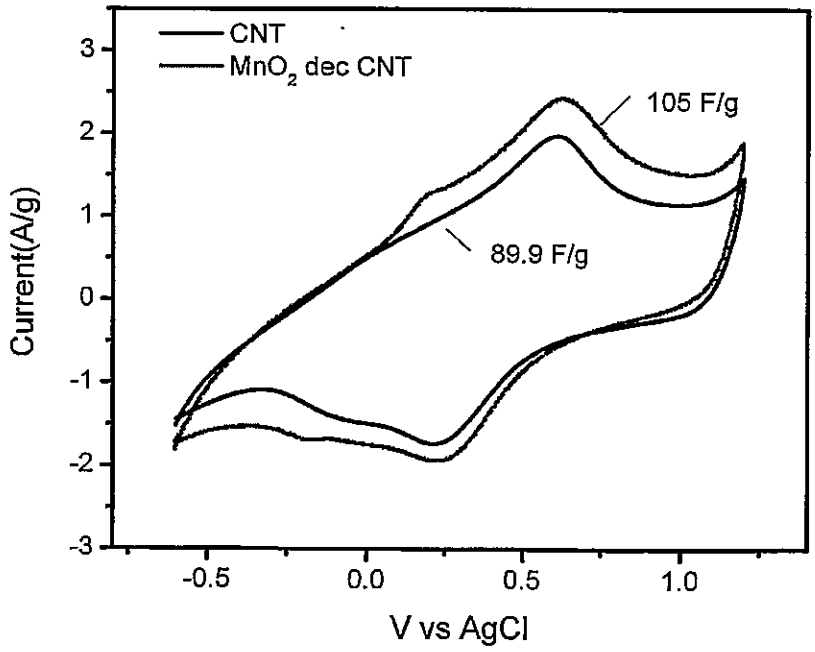

MnO2.0.154H2O 100.00 %
28,000
26,000
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
-2,000
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90

FIG. 20


CNT
MnO2 dec CNT
105 F/g
89.9 F/g
Current(A/g)
3
2
1
0
-1
-2
-3
-0.5
0.0
0.5
1.0
V vs AgCl