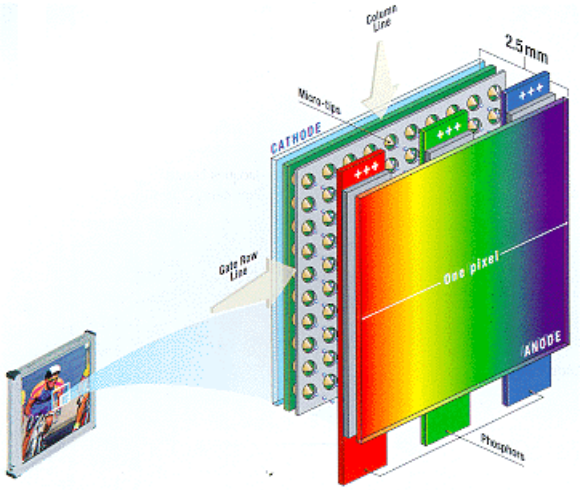
Symbol	Name	Formula	Value
$a_{C\text{-}C}$	carbon-carbon distance		1.421 Å (graphite)
a	length of unit vector	$\sqrt{3}a_{C\text{-}C}$	2.46 Å
$\boldsymbol{a}_1, \boldsymbol{a}_2$	unit vectors	$\left(\frac{\sqrt{3}}{2}, \frac{1}{2}\right)a, \left(\frac{\sqrt{3}}{2}, -\frac{1}{2}\right)a$	in (x, y) coordinates
$\boldsymbol{b}_1, \boldsymbol{b}_2$	reciprocal lattice vectors	$\left(\frac{1}{\sqrt{3}}, 1\right)\frac{2\pi}{a}, \left(\frac{1}{\sqrt{3}}, -1\right)\frac{2\pi}{a}$	in (x, y) coordinates
$\boldsymbol{C}_h$	chiral vector	$\boldsymbol{C}_h = n\boldsymbol{a}_1 + m\boldsymbol{a}_2 \equiv (n,m)$	n, m: integers
L	circumference of nanotube	$L = \left\|\boldsymbol{C}_h\right\| = a\sqrt{n^2 + m^2 + nm}$	$0 \le \|m\| \le n$
d_t	diameter of nanotube	$d_t = \frac{L}{\pi} = \frac{\sqrt{n^2 + m^2 + nm}}{\pi}a$	
θ	chiral angle	$\sin\theta = \frac{\sqrt{3}m}{2\sqrt{n^2 + m^2 + nm}}$ $\cos\theta = \frac{2n + m}{2\sqrt{n^2 + m^2 + nm}}$ $\tan\theta = \frac{\sqrt{3}m}{2n + m}$	$0 \le \|\theta\| \le 30°$
d	the highest common divisor of (n, m)		
d_R	the highest common divisor of $(2n+m, 2m+n)$	$d_R = \begin{cases} d & \text{if } n-m \text{ not a multiple of 3d} \\ 3d & \text{if } n-m \text{ a multipleof 3d} \end{cases}$	
$\boldsymbol{T}$	translation vector of 1D unit cell	$\boldsymbol{T} = t_1\boldsymbol{a}_1 + t_2\boldsymbol{a}_2$ $t_1 = \frac{2m+n}{d_R}$ $t_2 = -\frac{2n+m}{d_R}$	t_1, t_2: integers
T	length of $\boldsymbol{T}$	$T = \frac{\sqrt{3}L}{d_R}$	
N	number of hexagons per 1D unit cell	$N = \frac{2\left(n^2 + m^2 + nm\right)}{d_R}$	$2N \equiv n_C$/unit cell
$\boldsymbol{R}$	symmetry vector‡	$\boldsymbol{R} = p\boldsymbol{a}_1 + q\boldsymbol{a}_2 \equiv (p,q)$ $d = mp - nq,\ 0 \le p \le n/d,\ 0 \le q \le m/d$	p, q: integers†
M	number of 2π revolutions	$M = \left[\left(n2 + m\right)p + \left(2m + n\right)q\right]/d_R$	M: integer
R	Basic symmetry operation‡	$N\boldsymbol{R} = M\boldsymbol{C}_h + d\boldsymbol{T}$	
ψ	rotation operation	$R = \frac{\psi}{\tau}$	ψ: radians
τ	translation operation	$\tau = \frac{d\boldsymbol{T}}{N}$	τ, χ: length

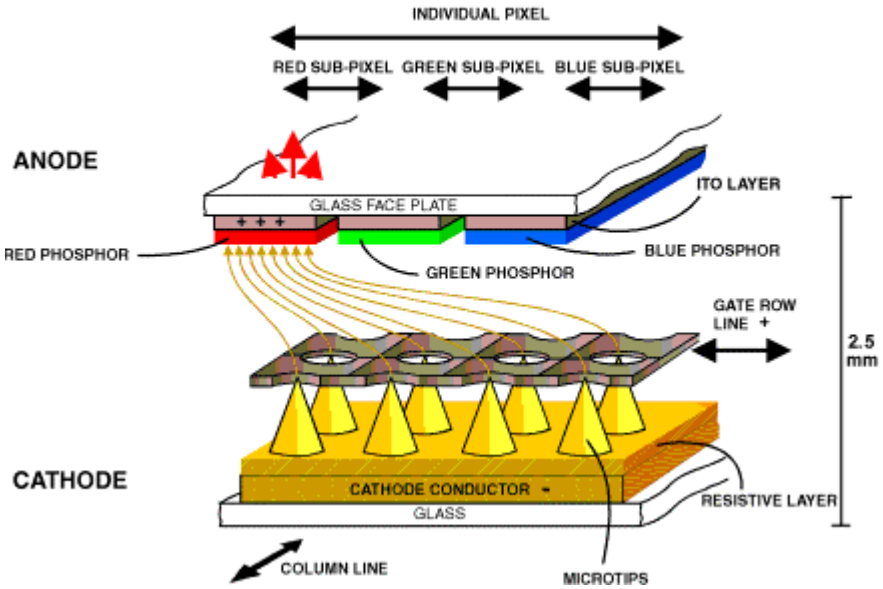
† (p,q) are uniquely determined by $d = mp - nq$, subject to conditions stated in table, except for zigzag tubes which $\boldsymbol{C}_h = (n, 0)$, and we define $p = 1$, $q = -1$, which gives $M = 1$.

‡ $\boldsymbol{R}$ and R refer to the same symmetry operation.

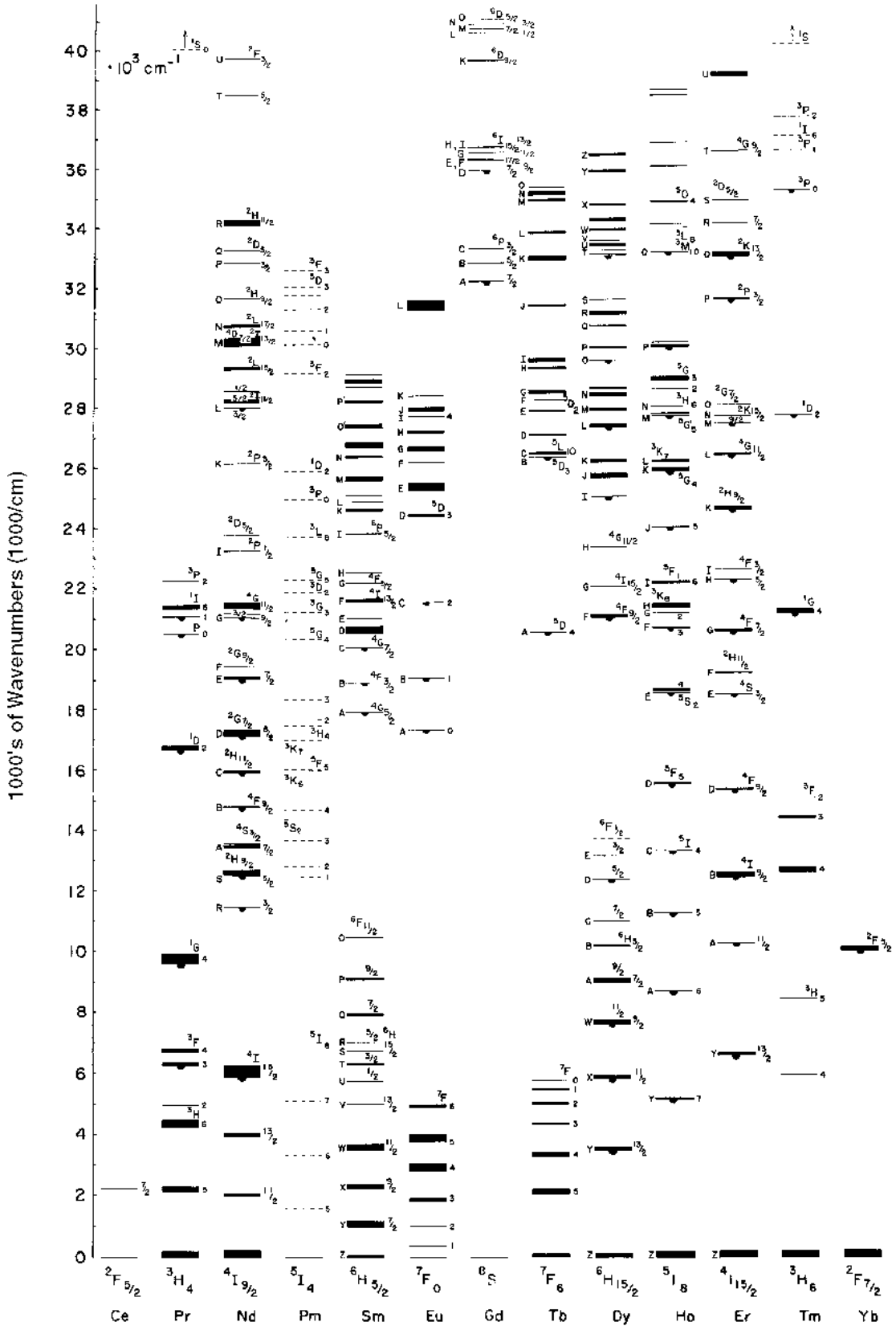
Tab. 2



Field Emission Display

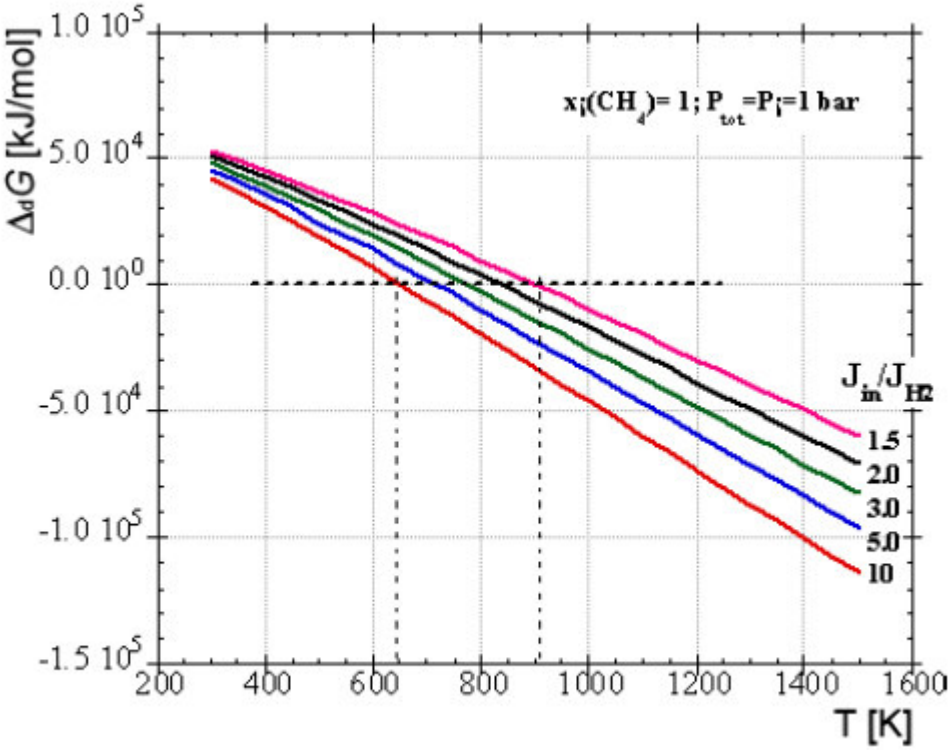


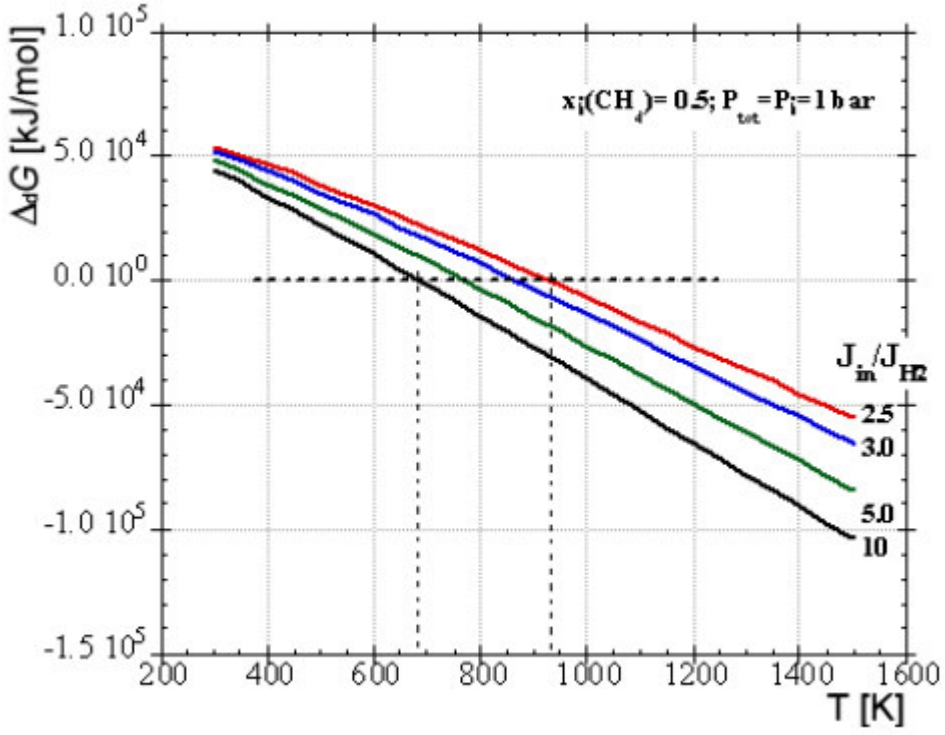
Classic 'Dieke Diagram' for Rare Earth Ions



G. H. Dieke. Spectra and energy levels of rare earth ions in crystals (Interscience Publishers. New York. 1968)

Fig. 17


$x_i(CH_4)= 1; P_{tot}=P_i=1$ bar
$\Delta_d G$ [kJ/mol]
1.0 10^5
5.0 10^4
0.0 10^0
-5.0 10^4
-1.0 10^5
-1.5 10^5
200
400
600
800
1000
1200
1400
1600
T [K]
J_{in}/J_{H2}
1.5
2.0
3.0
5.0
10


$x_i(CH_4)= 0.5; P_{tot}=P_i=1$ bar
$\Delta_d G$ [kJ/mol]
1.0 10^5
5.0 10^4
0.0 10^0
-5.0 10^4
-1.0 10^5
-1.5 10^5
200
400
600
800
1000
1200
1400
1600
T [K]
J_{in}/J_{H2}
2.5
3.0
5.0
10

Figg. 24-25

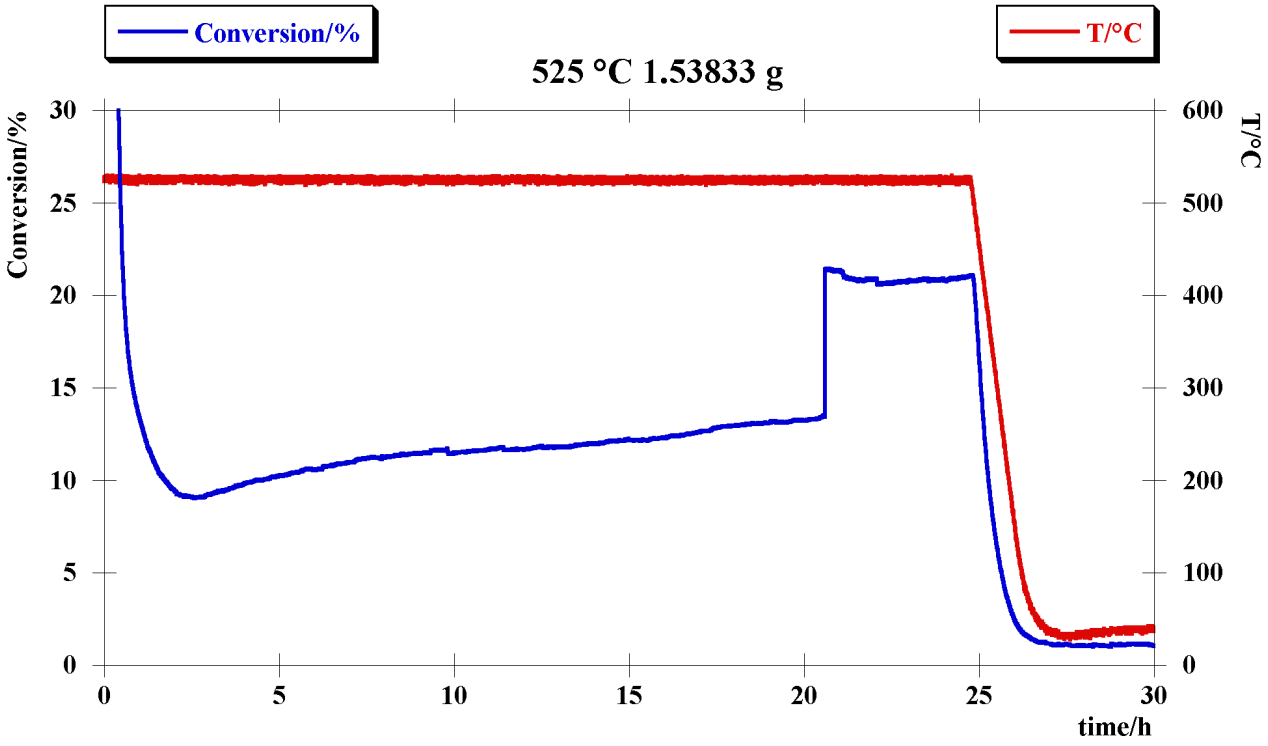

Conversion/%
T/°C
525 °C 1.53833 g
Conversion/%
T/°C
time/h
0
5
10
15
20
25
30
0
100
200
300
400
500
600

Fig. 41

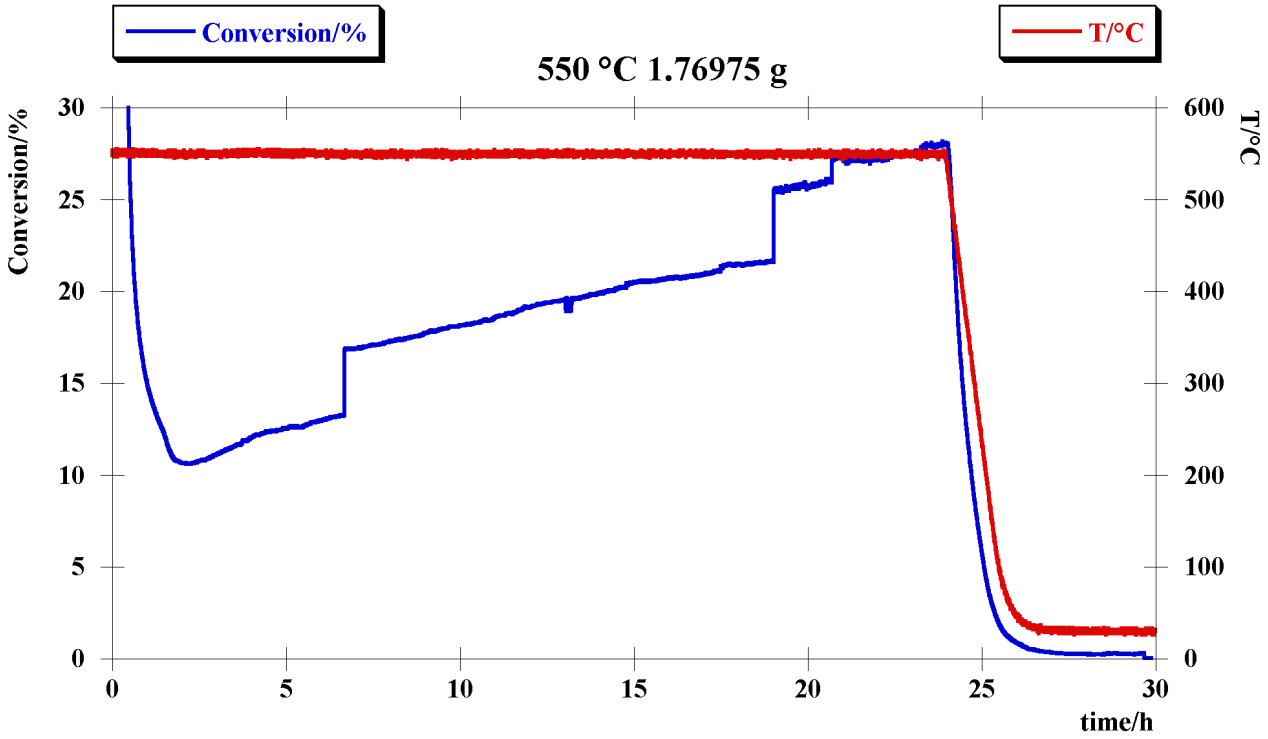

Conversion/%
T/°C
550 °C 1.76975 g
Conversion/%
T/°C
time/h
0
5
10
15
20
25
30
0
100
200
300
400
500
600

Fig. 42

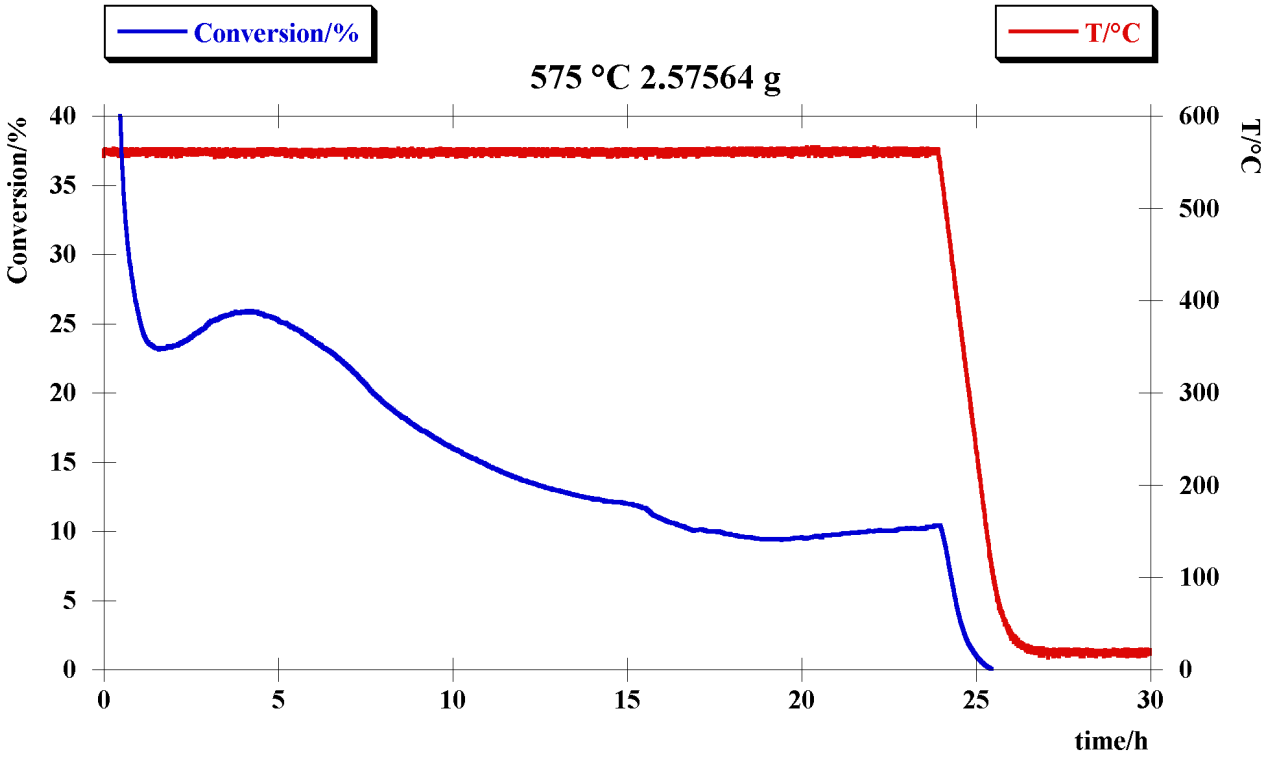

Conversion/%
T/°C
575 °C 2.57564 g
Conversion/%
T/°C
time/h
0
5
10
15
20
25
30
0
5
10
15
20
25
30
35
40
0
100
200
300
400
500
600

Fig. 43

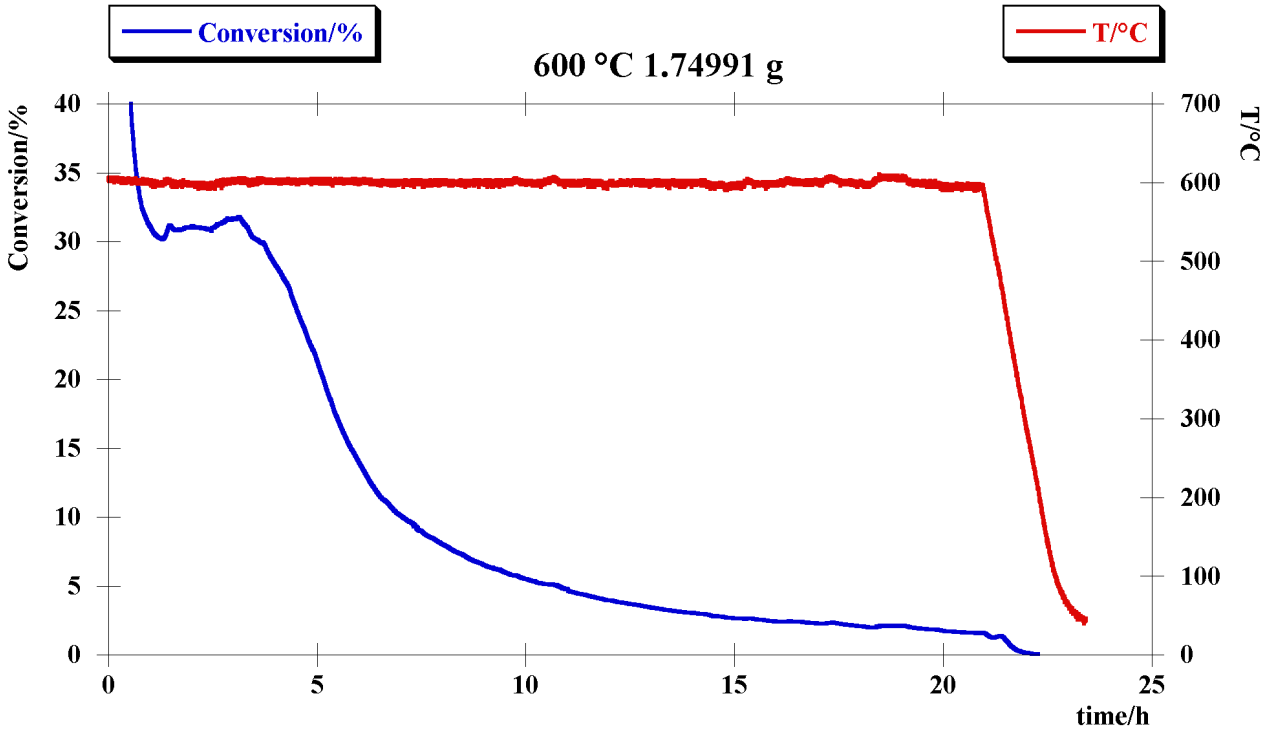

Conversion/%
T/°C
600 °C 1.74991 g
Conversion/%
T/°C
time/h
0
5
10
15
20
25
0
5
10
15
20
25
30
35
40
0
100
200
300
400
500
600
700

Fig. 44

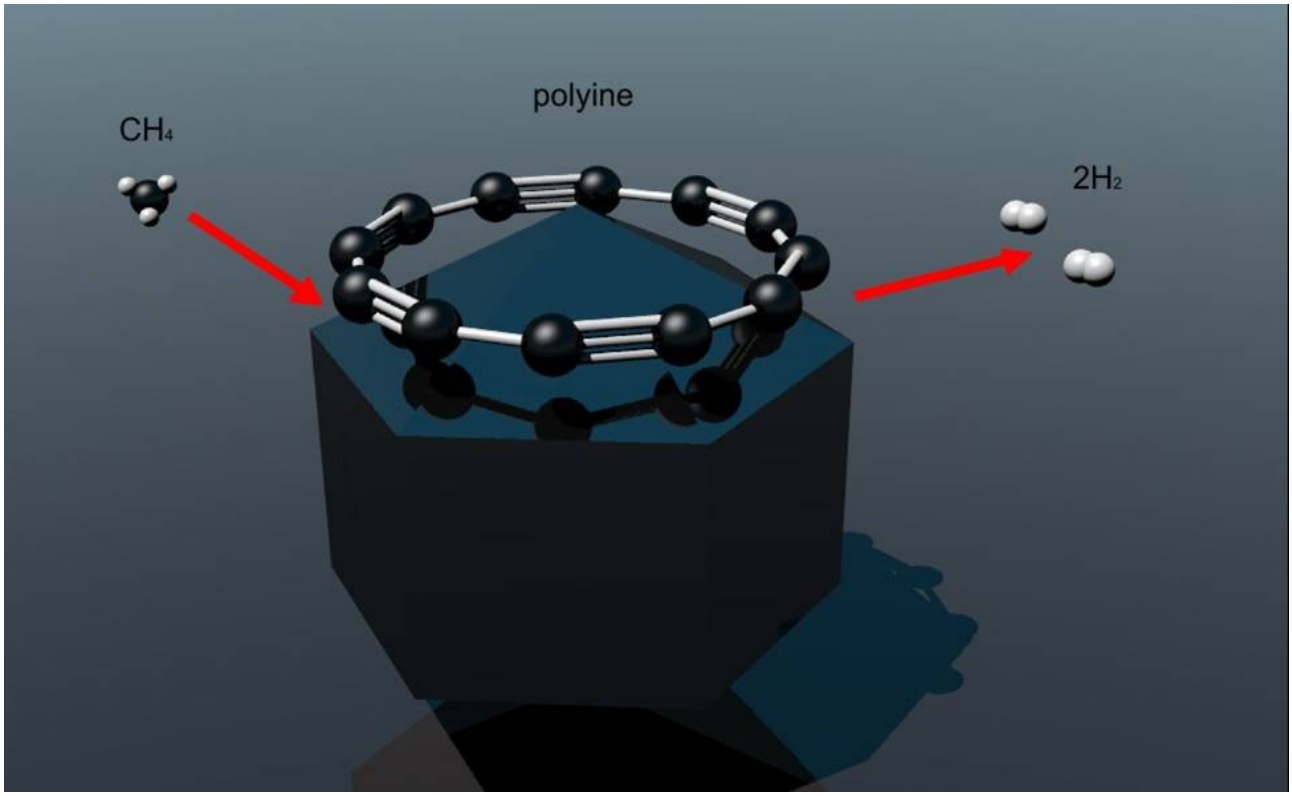


Fig. 65

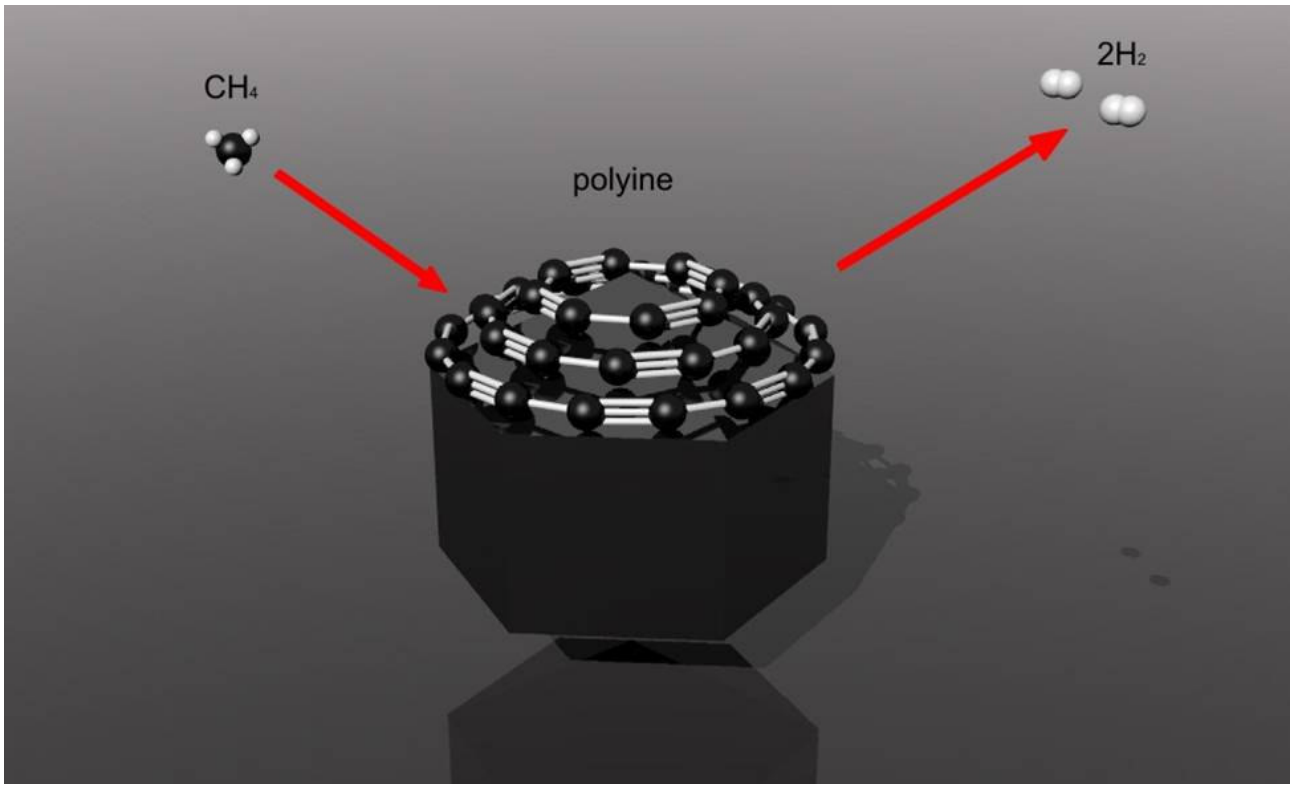


Fig. 66

475 °C:

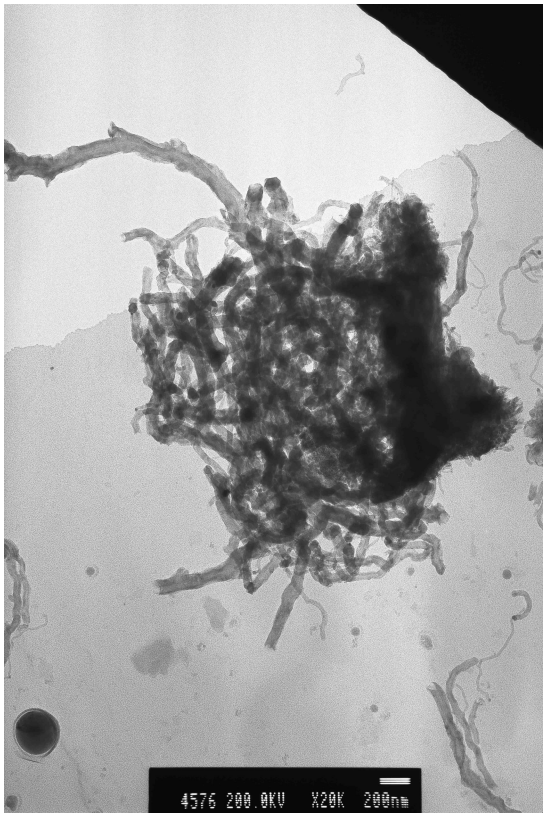


Fig. 68

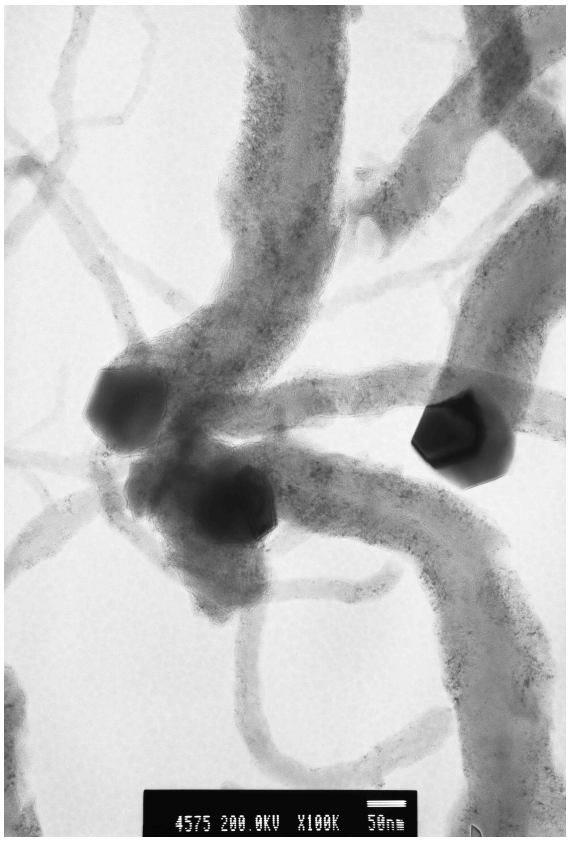


Fig. 69

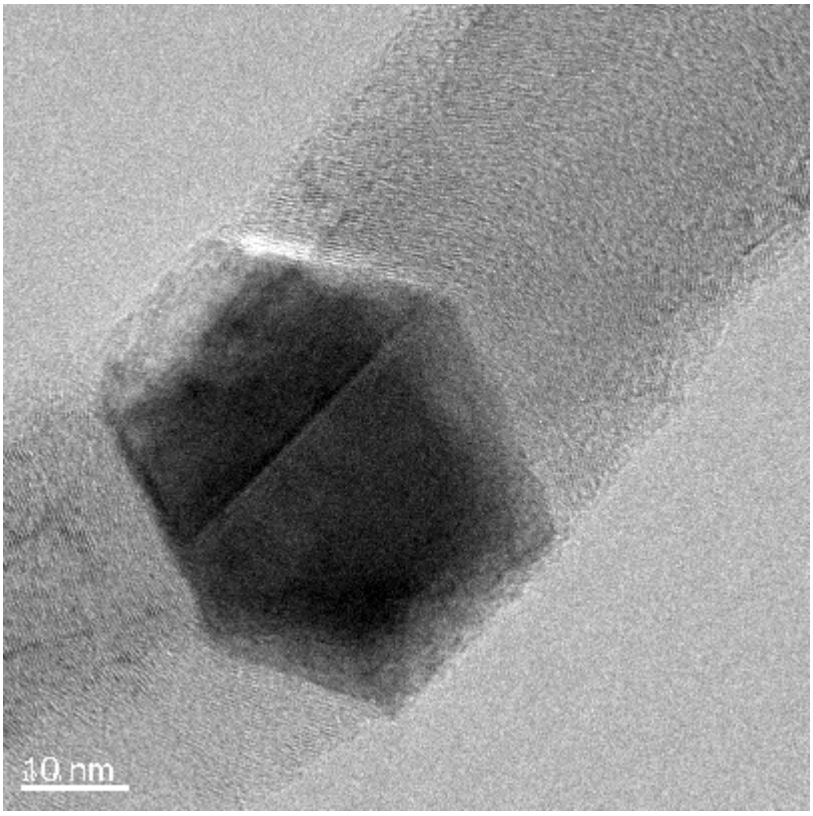


Fig. 70

Metal nanoparticle with two attached CNTs. A stacking fault in the nanoparticle is clearly visible.

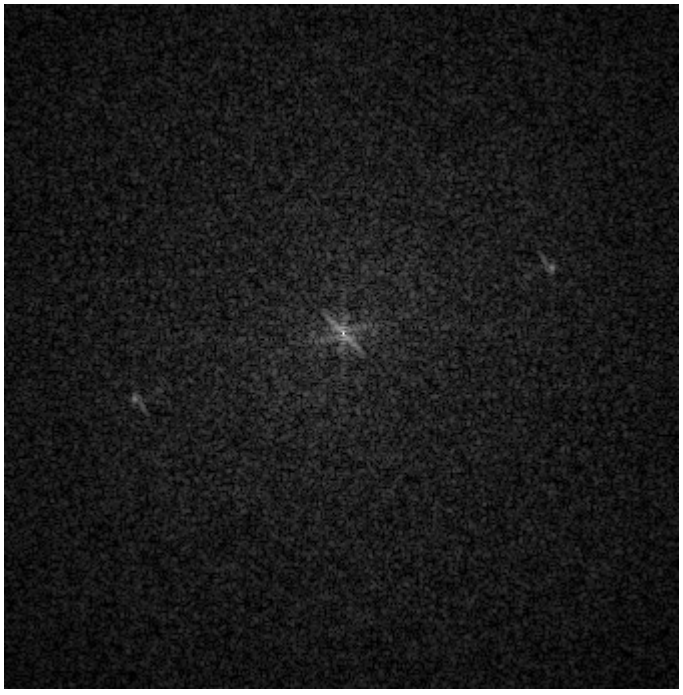


Fig. 71

Fourier transform of the image of the metal nanoparticle in fig. 70.

500 °C:

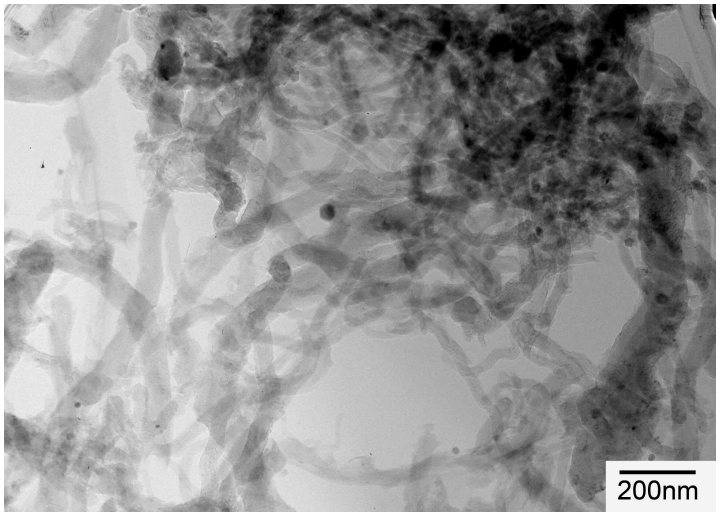


Fig. 72

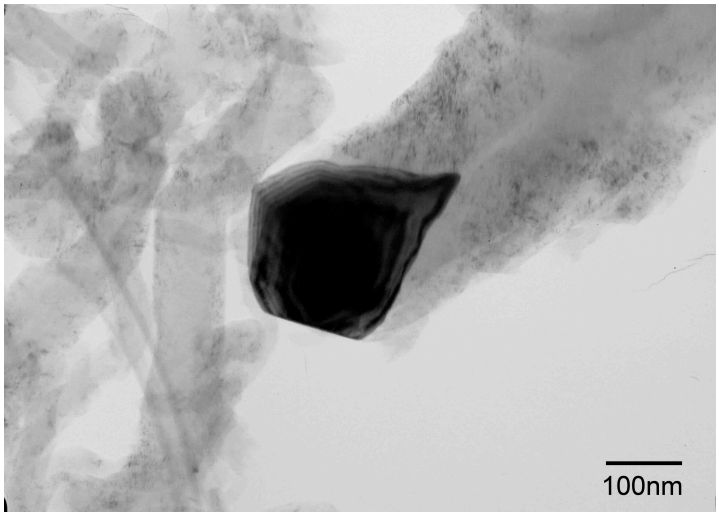


Fig. 73

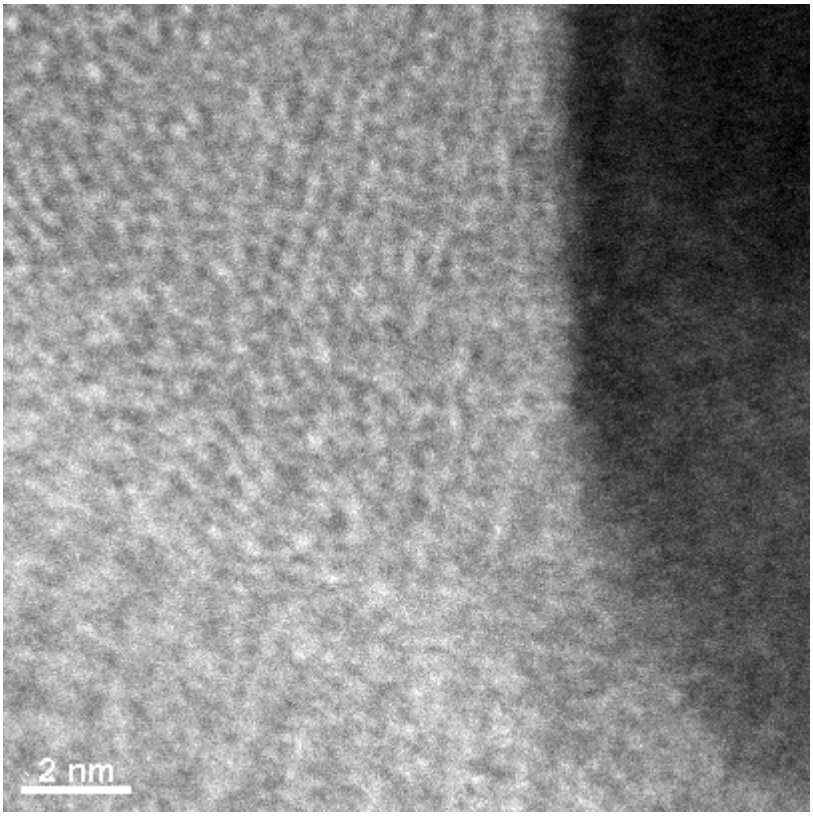


Fig. 74

Fig. 73 metal nanoparticle-CNT interface.

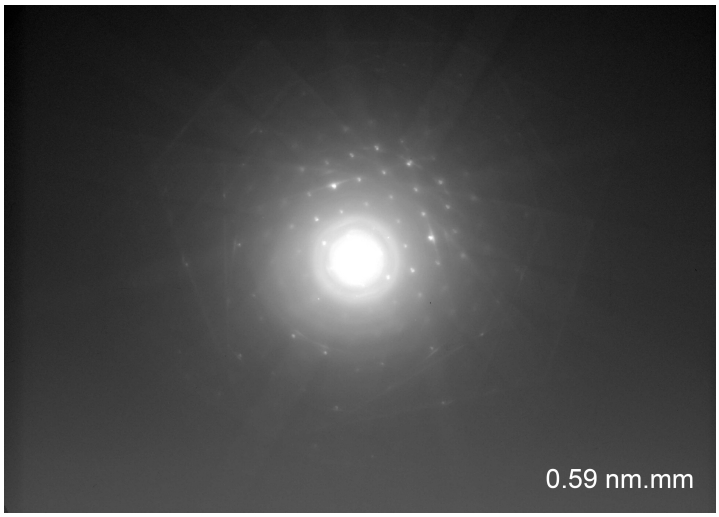


Fig. 75

Electron diffraction pattern of the metal nanoparticle shown in fig. 73.

525 °C:

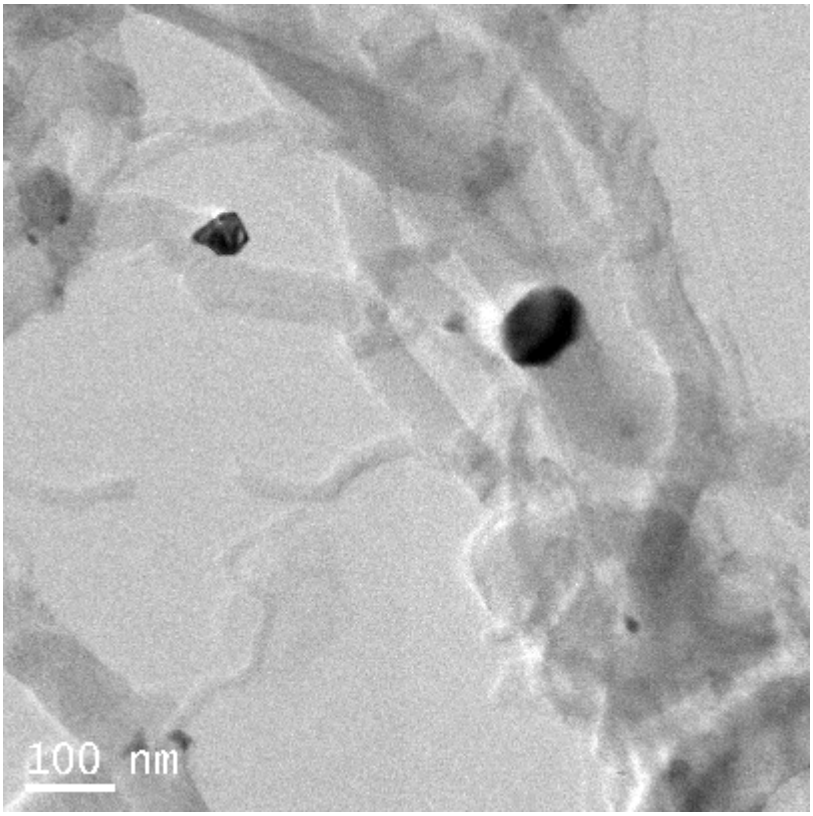


Fig. 76

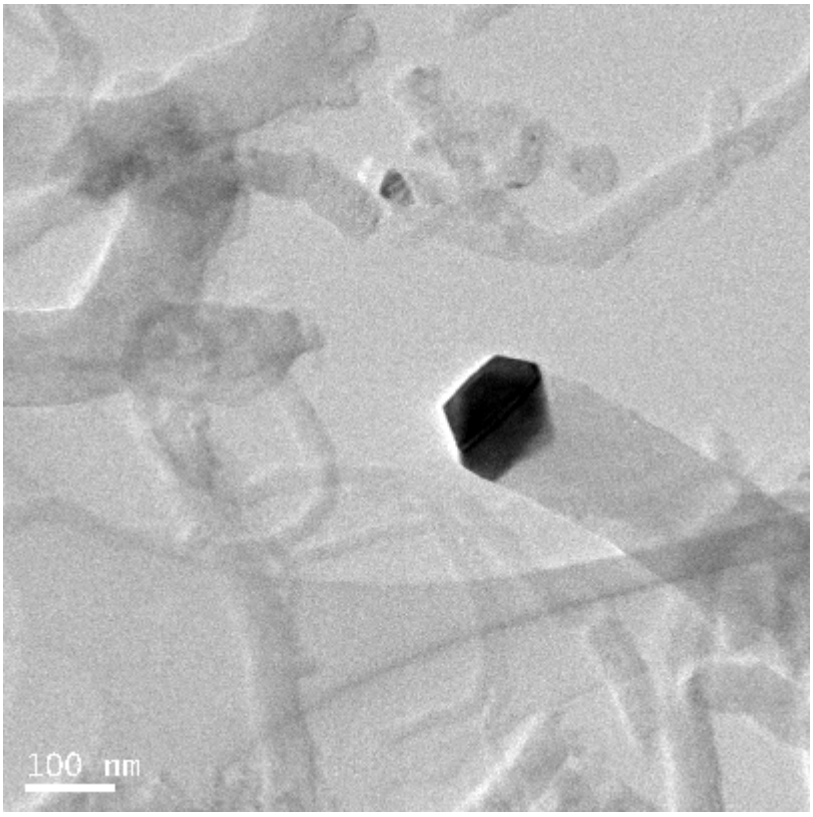


Fig. 77

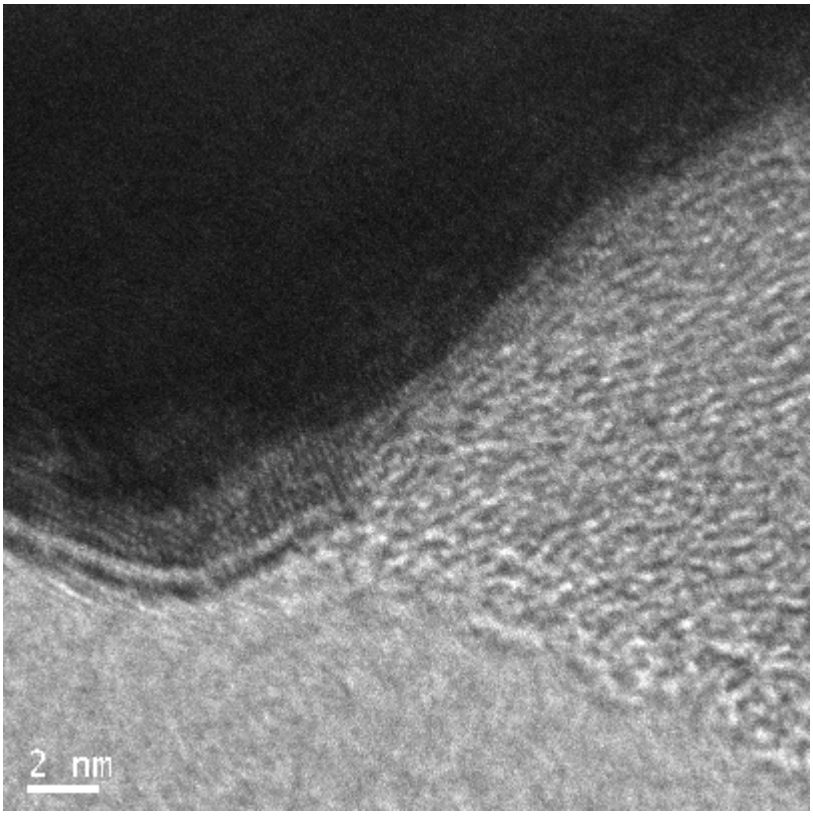


Fig. 78

Fig. 77 metal nanoparticle-CNT interface.

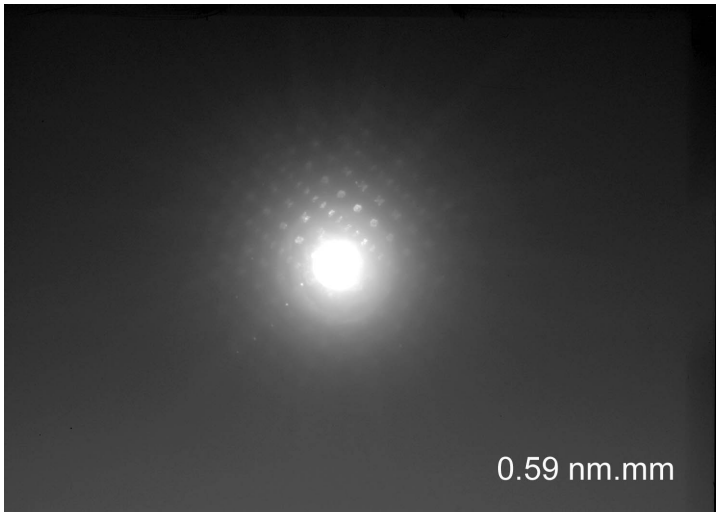


Fig. 79

Electron diffraction pattern of the metal nanoparticle shown in fig. 77.

550 °C:

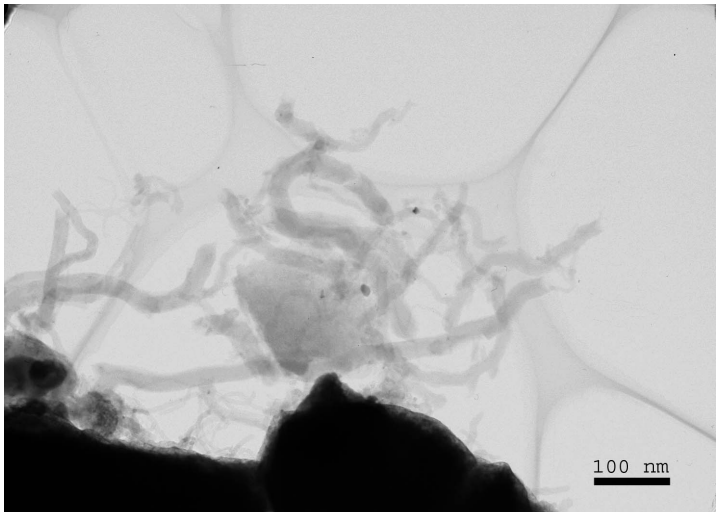


Fig. 80

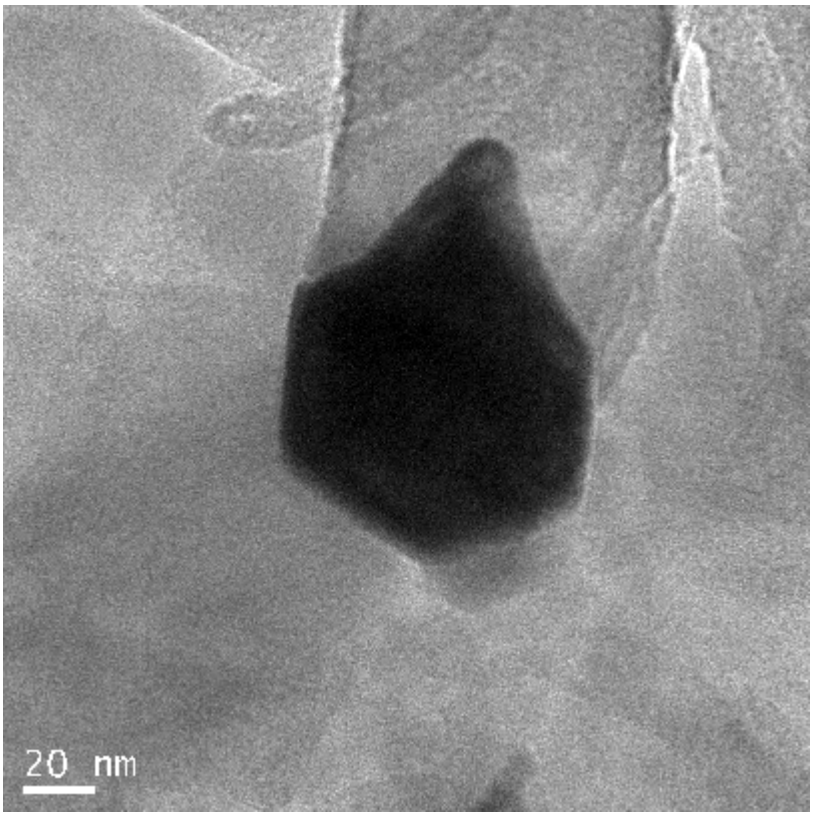


Fig. 81

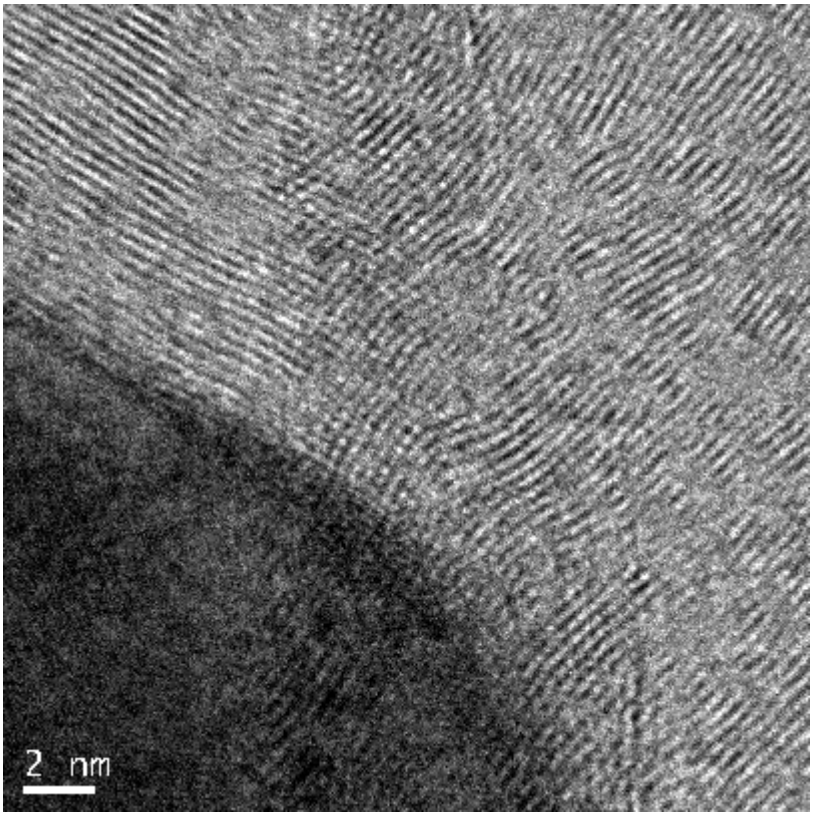


Fig. 82

Fig. 81 metal nanoparticle-CNT interface.

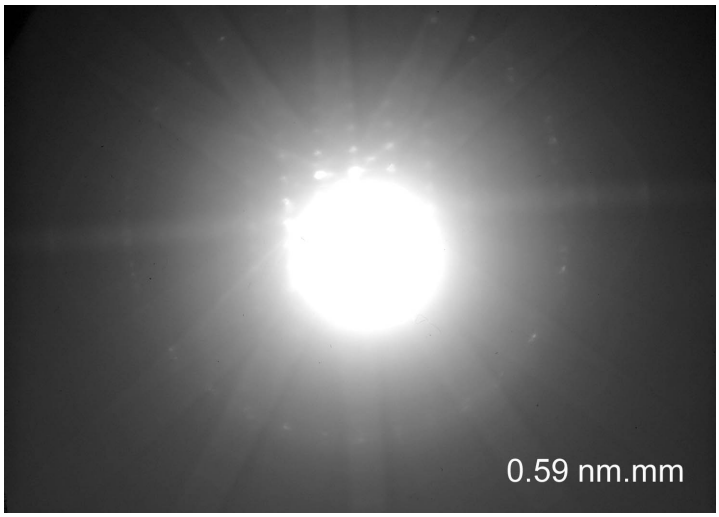


Fig. 83

Electron diffraction pattern of the metal nanoparticle shown in fig. 77.

575 °C:

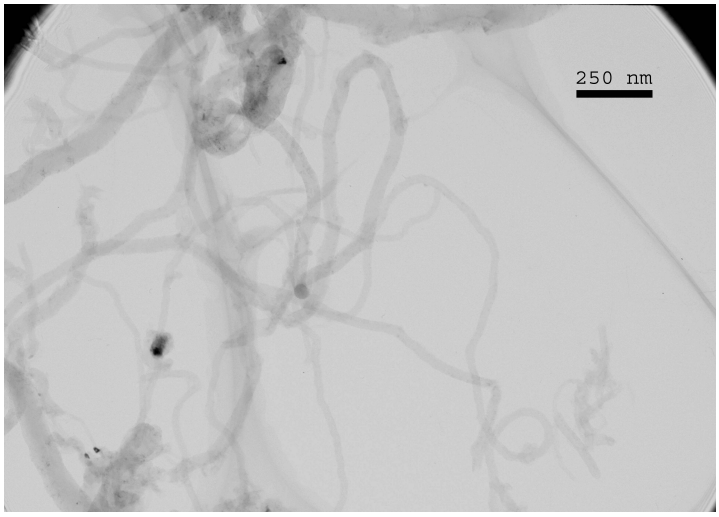


Fig. 84

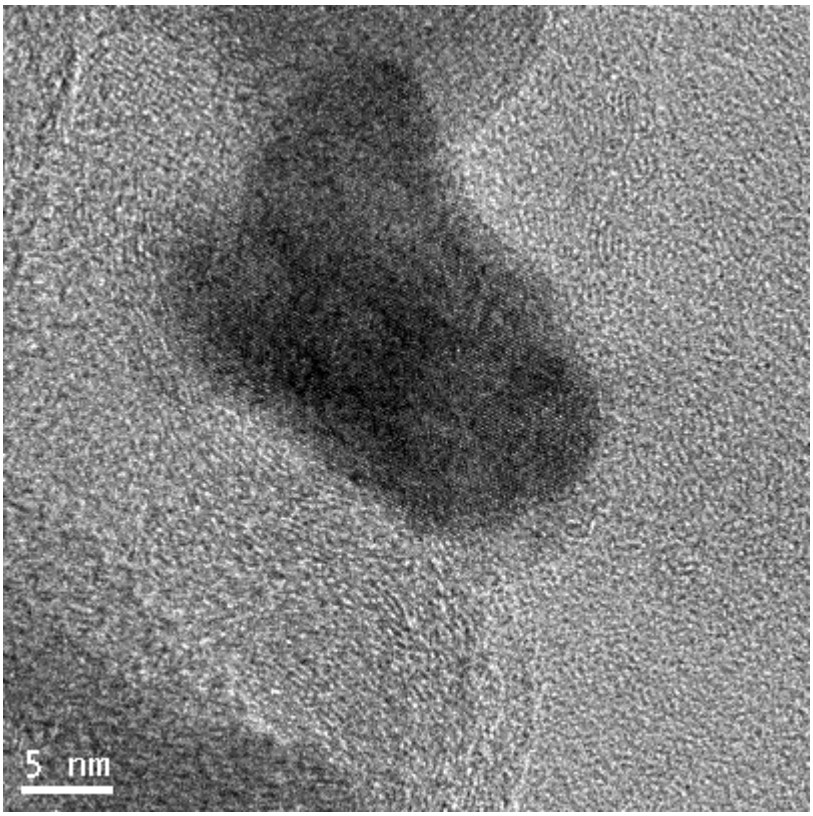


Fig. 85