5 Maggio 2015
Progetto Lauree Scientifiche

Oh, i posti che visiterai!

(con il grafene ed i nanotubi di carbonio)

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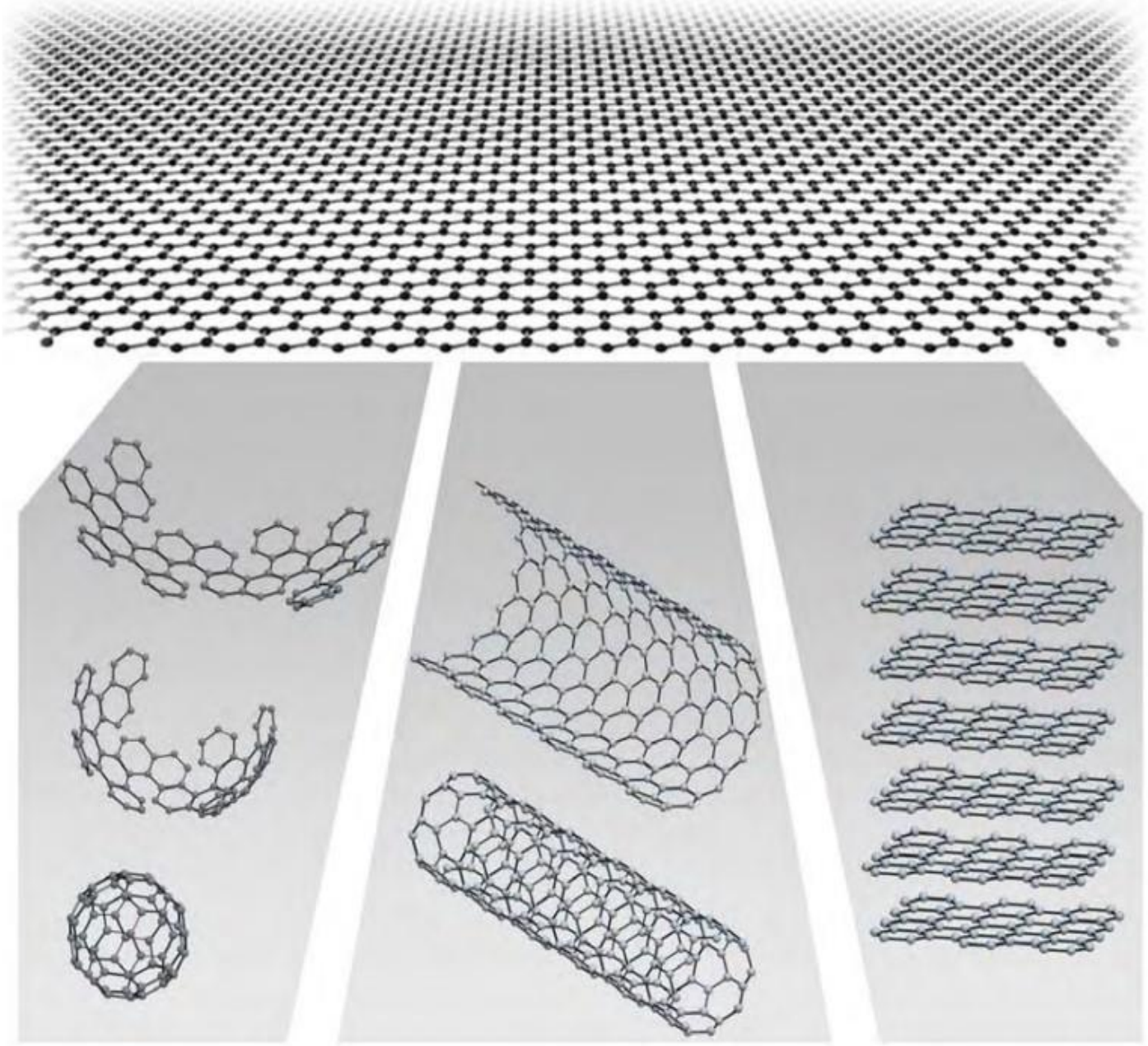
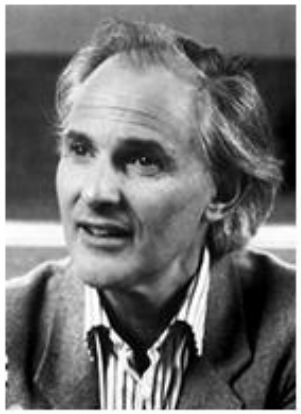


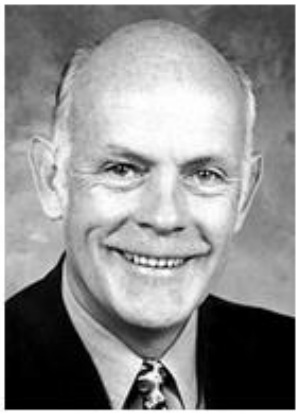
Figure 1. **Mother of all graphitic forms.** Graphene is a 2D building material for carbon materials of all other dimensionalities. It can be wrapped up into 0D buckyballs, rolled into 1D nanotubes or stacked into 3D graphite.

The Nobel Prize in Chemistry 1996

Robert F. Curl Jr.
Prize share: 1/3

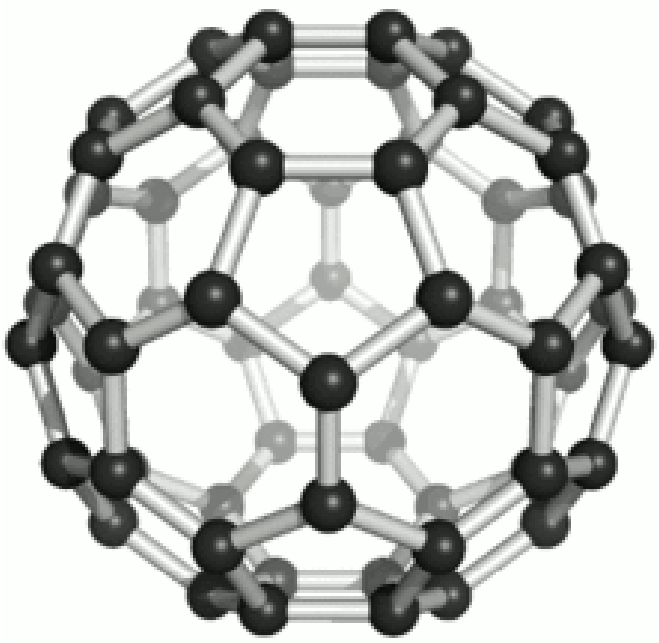


Sir Harold W. Kroto
Prize share: 1/3



Richard E. Smalley
Prize share: 1/3

The Nobel Prize in Chemistry 1996 was awarded jointly to Robert F. Curl Jr., Sir Harold W. Kroto and Richard E. Smalley *"for their discovery of fullerenes"*.



The Nobel Prize in Physics 2010

Photo: U. Montan

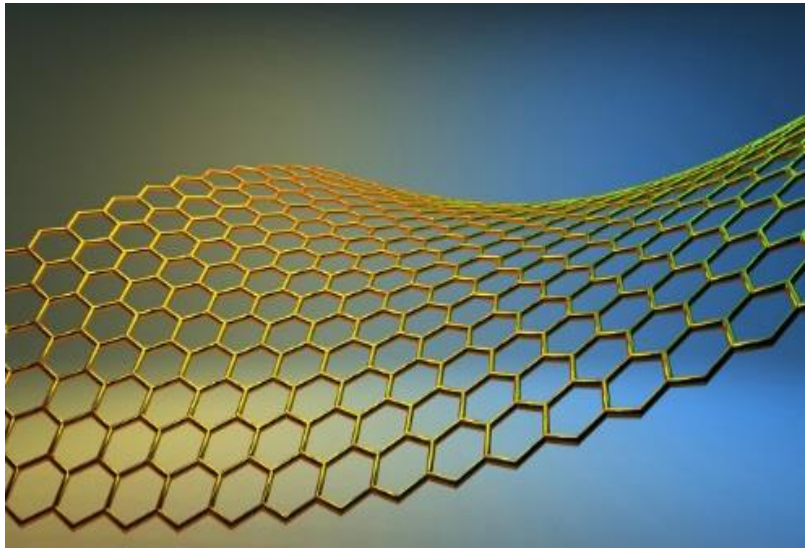
Andre Geim

Prize share: 1/2

Photo: U. Montan

Konstantin Novoselov

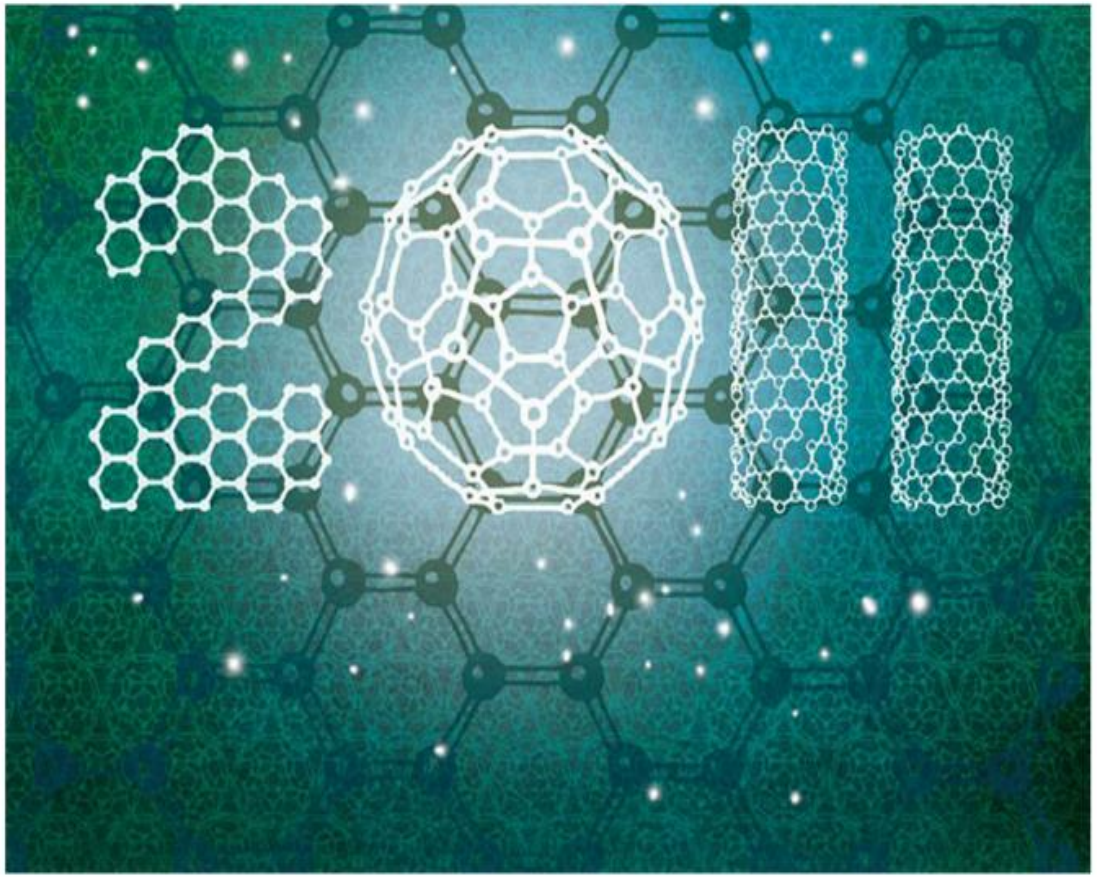
Prize share: 1/2



The Nobel Prize in Physics 2010 was awarded jointly to Andre Geim and Konstantin Novoselov *"for groundbreaking experiments regarding the two-dimensional material graphene"*

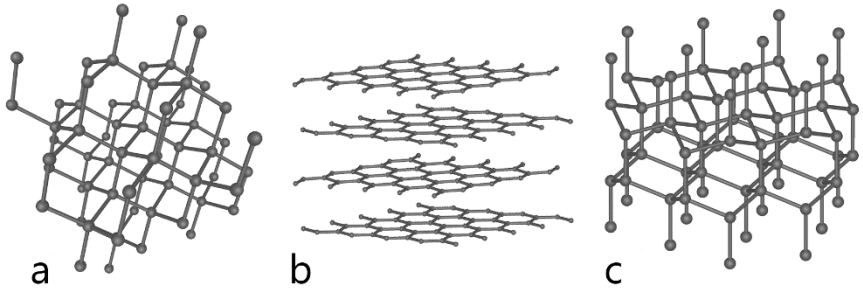
NATURE | EDITORIAL

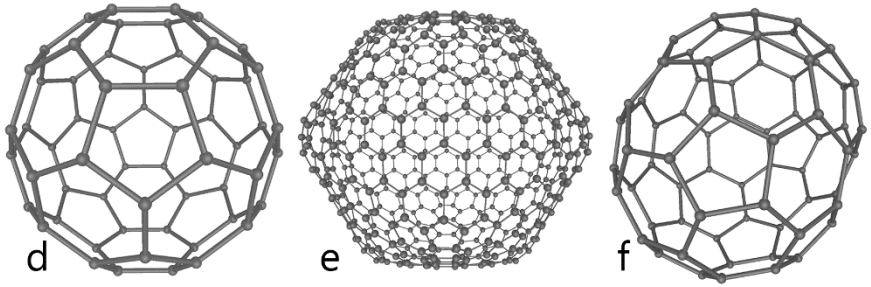
INTERNATIONAL YEAR OF CHEMISTRY

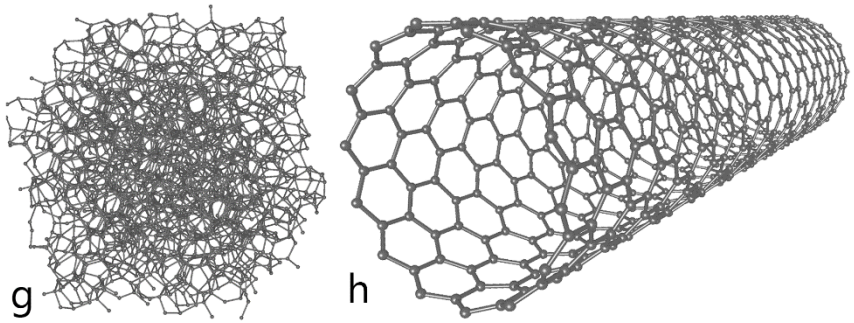


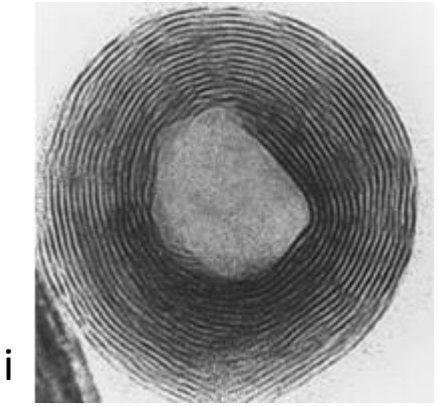
2011: YEAR OF CHEMISTRY

Celebrating the central science



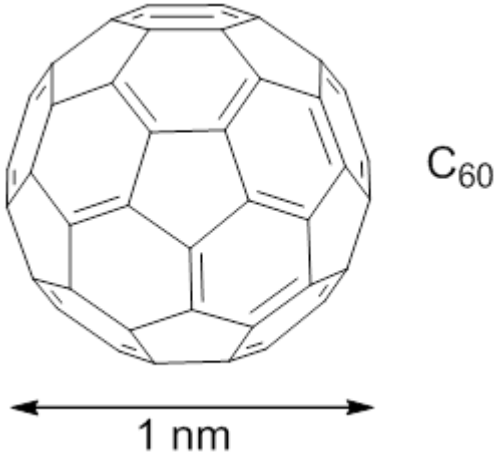




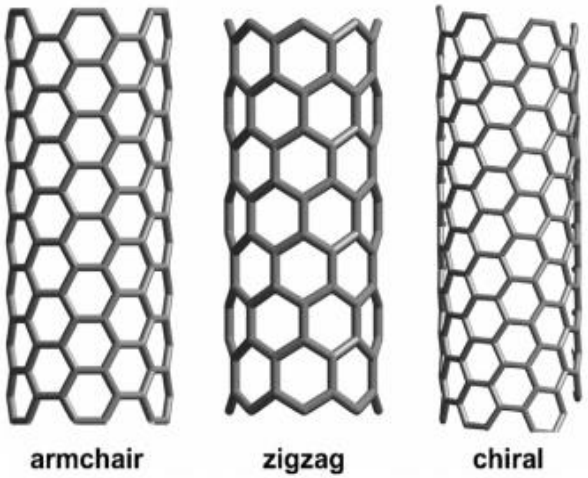


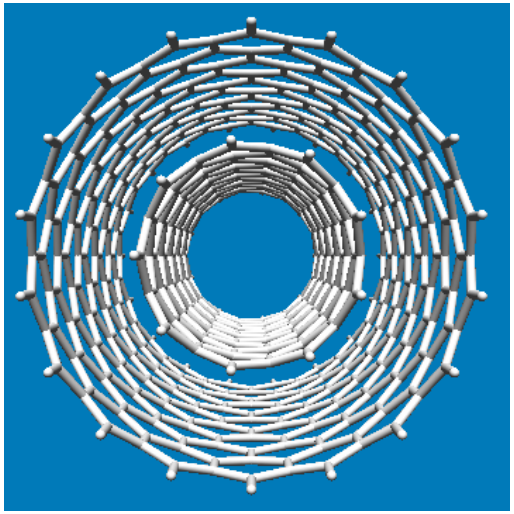
a) Diamante
b) Grafite
c) Losdaleite
d) Forme fullereniche
e) Forme fullereniche
f) Forme fullereniche
g) Carbone amorfo
h) Nanoptubi di carbonio
i) Nano cipolle

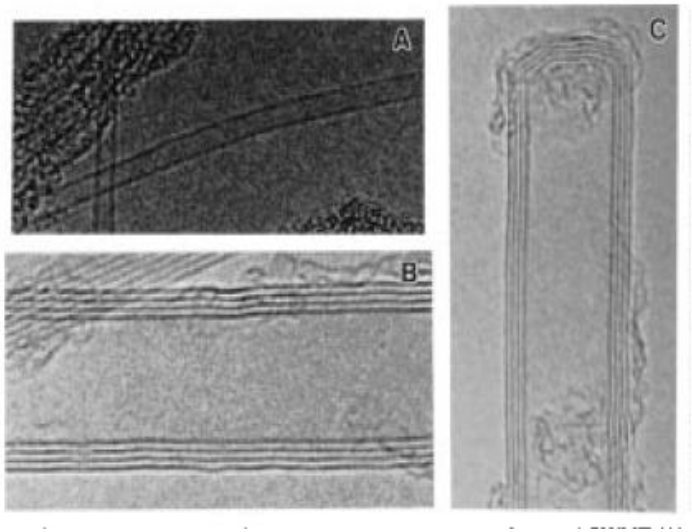
Fullerene

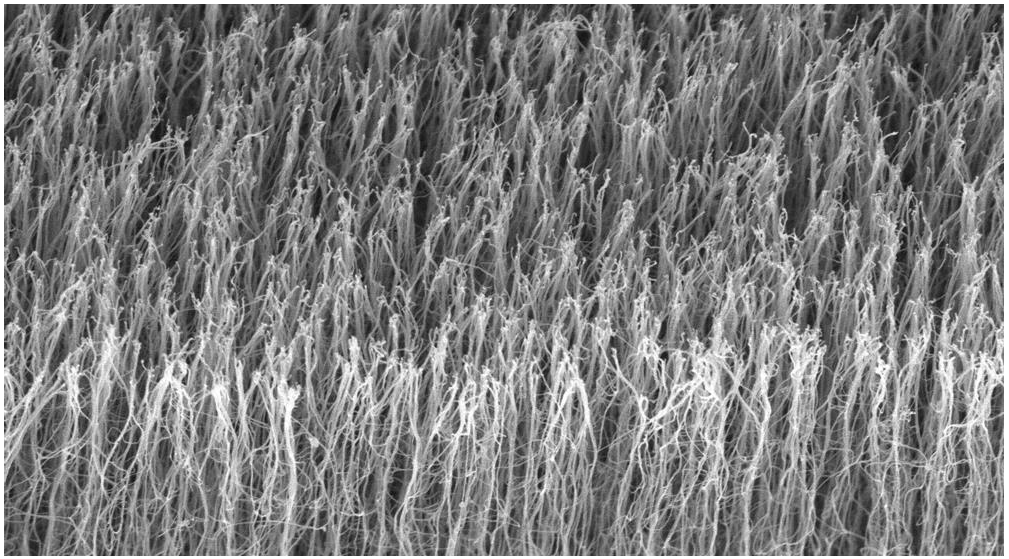


Nanotubi di carbonio









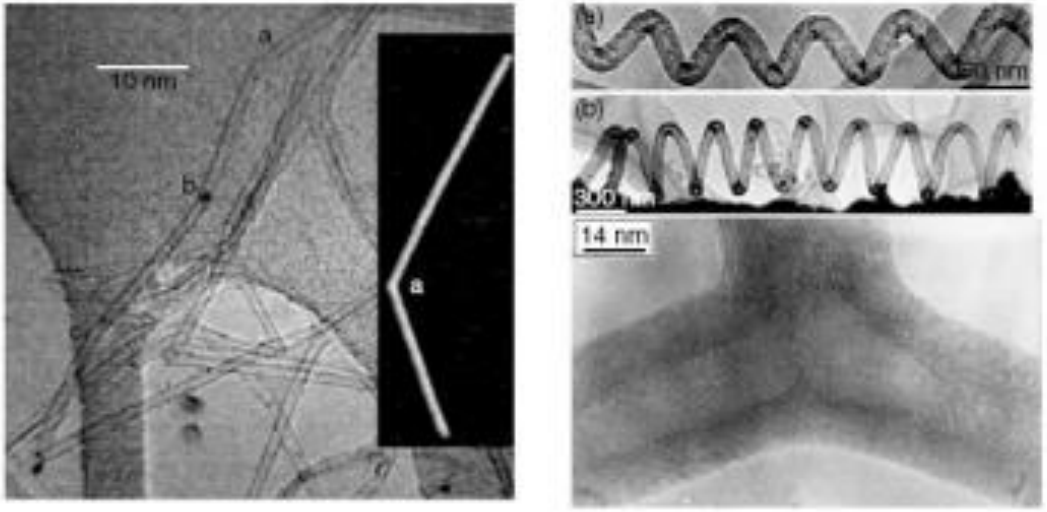
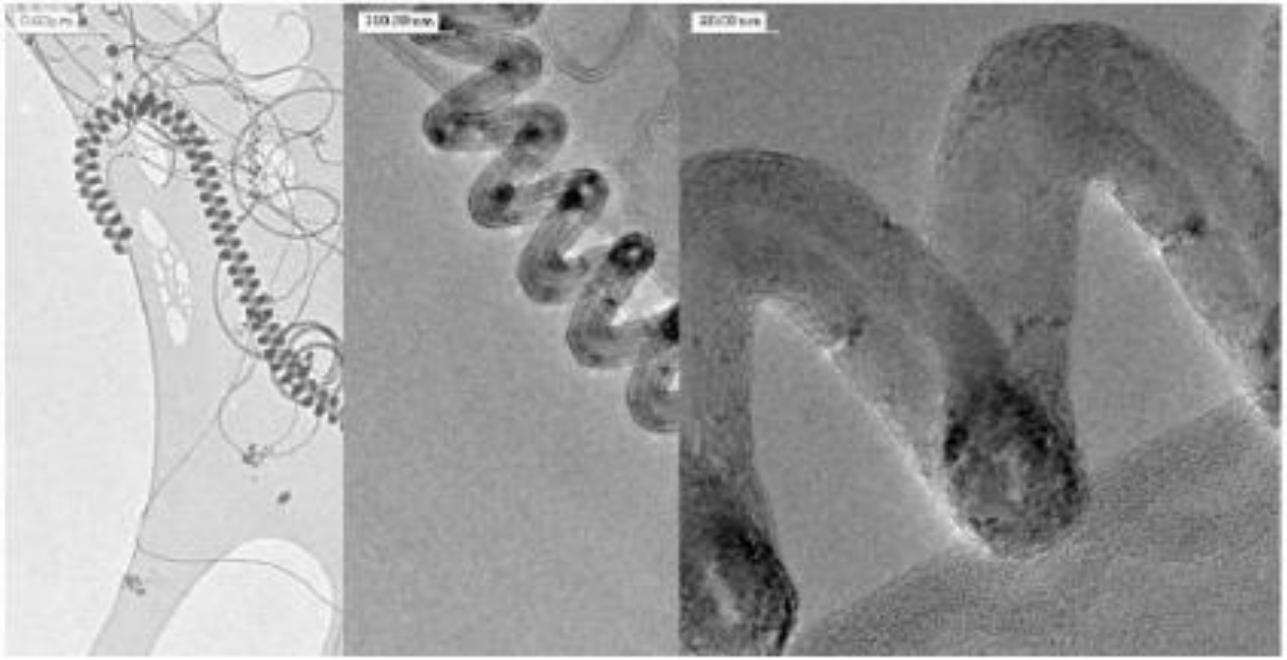


FIGURE 1.5 Representative TEM and AFM (insert) images of the individual SWNT bends. (a), (b) and (c) denote three typical bend angles of 34°, 26°, and 18°[18], MWNT coils [17], and Y branches [16]. (Figure 1.5a from Zhang et al., Appl. Phys. Lett., 83, 423, 2003; Figure 1.5c from Satishkumar et al., Appl. Phys. Lett., 77, 2530, 2000.)



Grafene

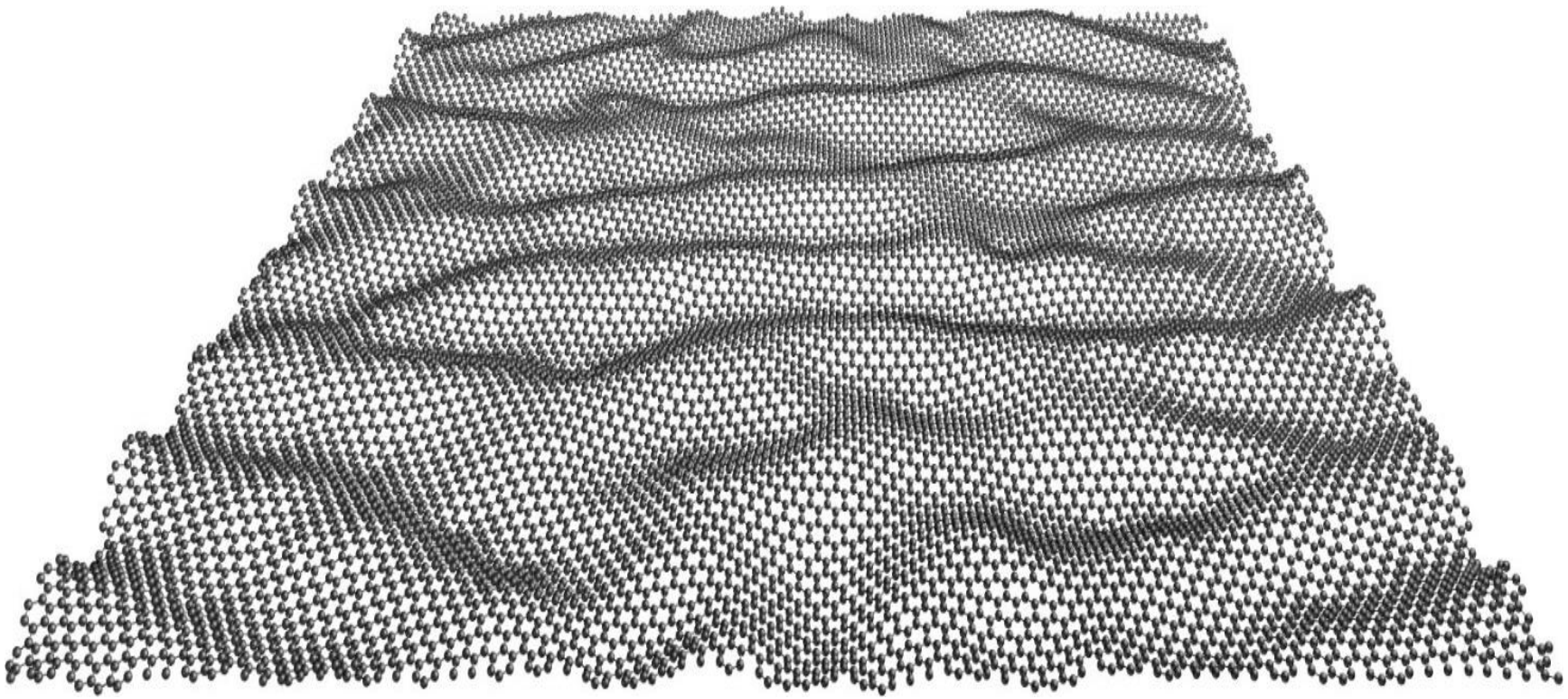


Figura 1.13 Un carbonio ibridizzato sp^2. I tre **orbitali ibridi sp^2** equivalenti (verde) giacciono in un piano ad un angolo di 120° l'uno rispetto all'altro, ed un singolo orbitale *p* non ibridizzato (rosso/blu) è perpendicolare al piano sp^2.

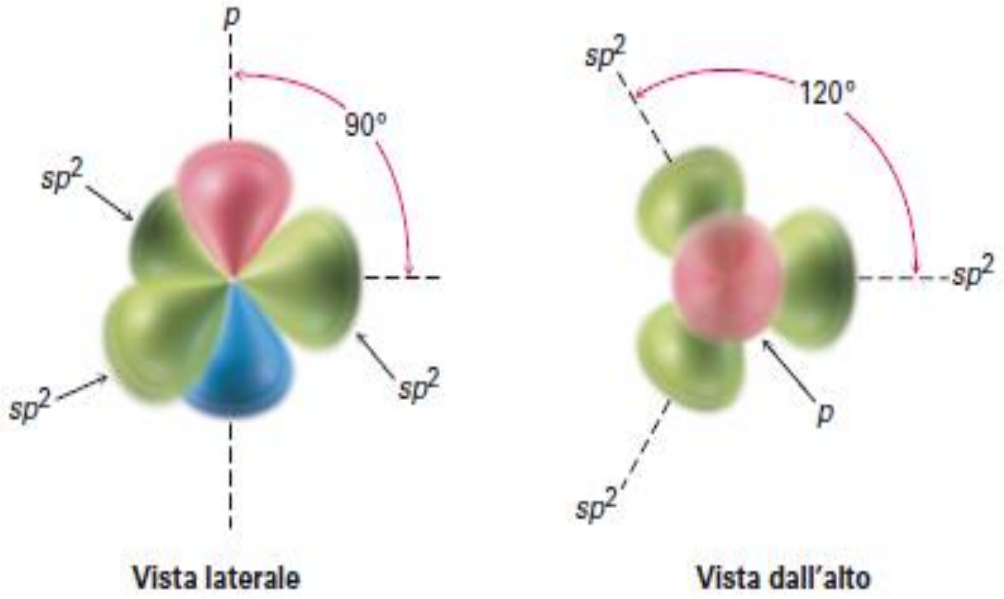
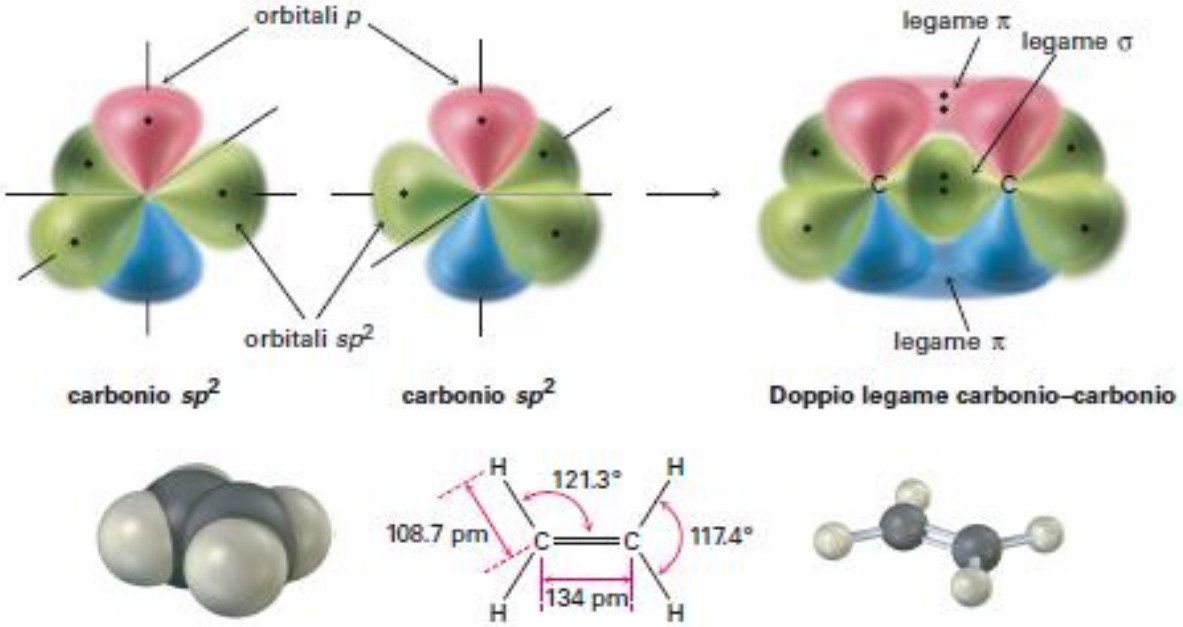
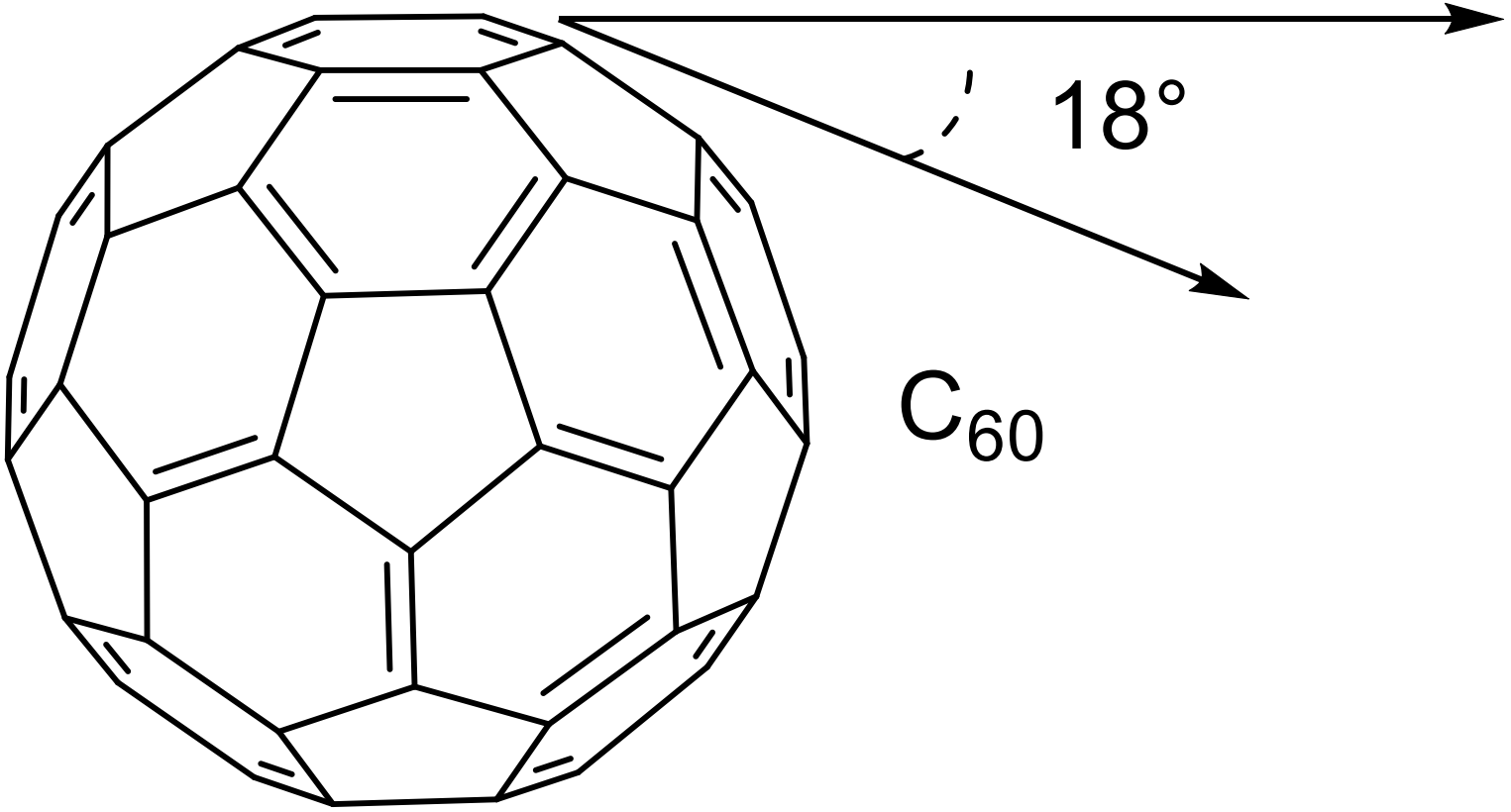


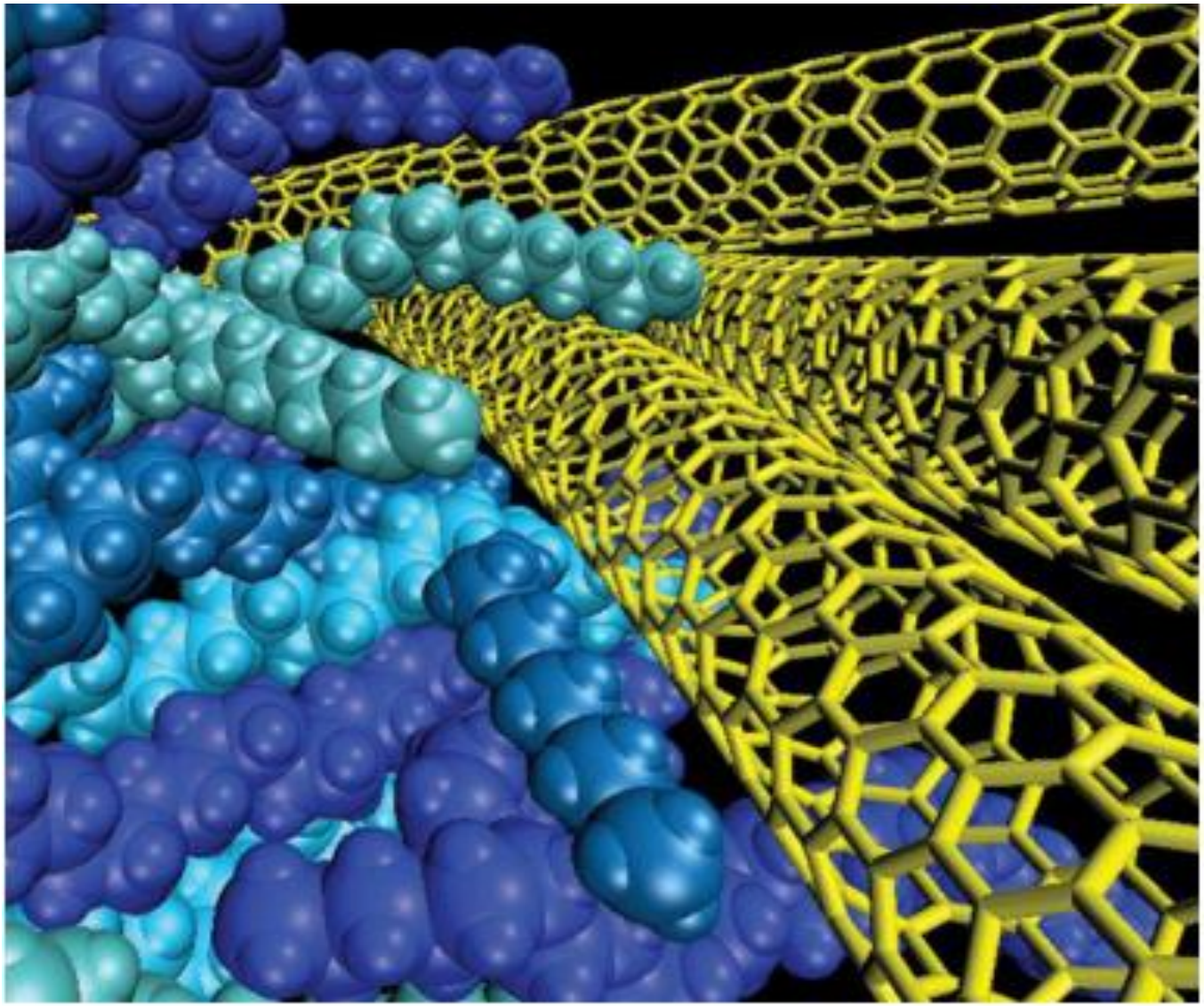
Figura 1.14 Struttura dell'etilene. Sovrapposizione degli orbitali di due atomi di carbonio ibridizzati sp^2 a formare un doppio legame carbonio-carbonio. Una parte del doppio legame deriva dalla sovrapposizione σ (testa- testa) degli **orbitali sp^2**, e l'altra parte deriva dalla sovrapposizione π (laterale) degli orbitali *p* non ibridizzati (rosso/blu). Il legame π ha regioni di densità elettronica su ciascun lato di una linea tracciata tra i nuclei.

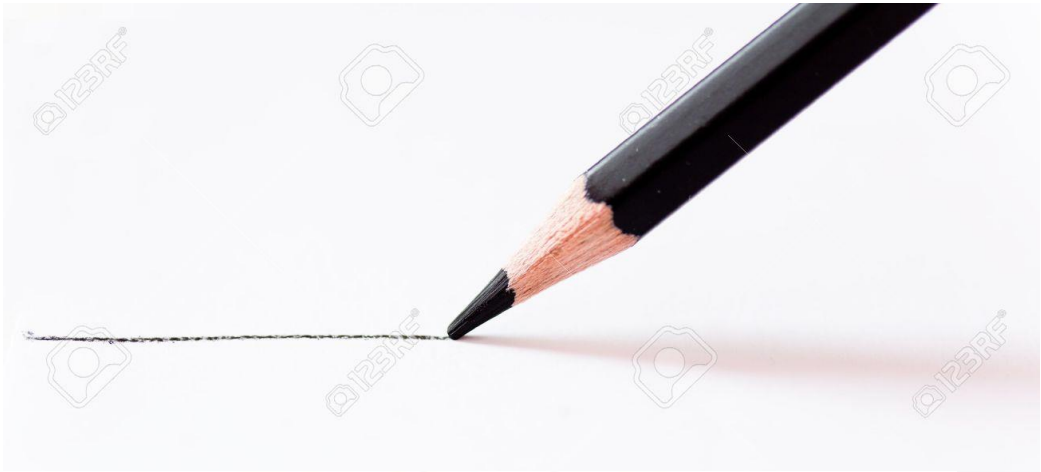



18°
C60

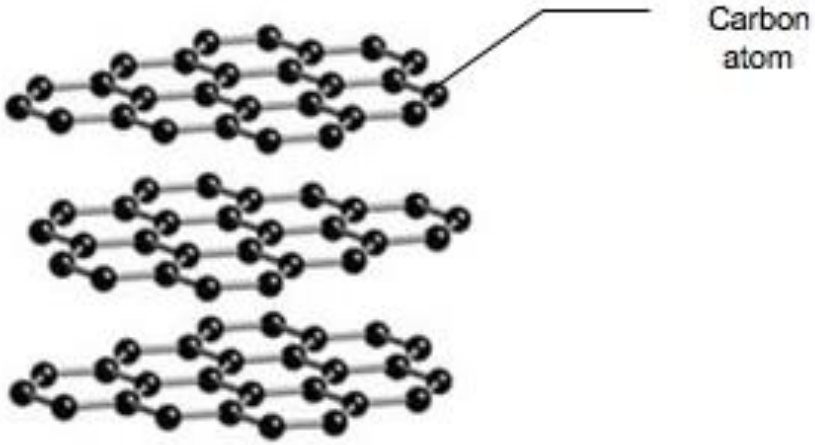
TI VUOI SCIOGLIERE
O NO!

Solvente	*Solubilità C_{60} (mg/mL)*
n-pentano	0.005
decalina	4.6
dodecano	0.091
cicloesano	0.036
CCl_4	0.32
CH_2Cl_2	0.254
metanolo	0
etanolo	0.001
benzene	1.7
toluene	2.8
xileni	5.2
bromo benzene	3.3
1,2-diclorobenzene	27.0
1-cloronaftalene	51
Disolfuro di carbonio	7.9
2-metiltiofene	6.8
tetraidrofurano	0





Structure of Graphite



Graphene.mp4

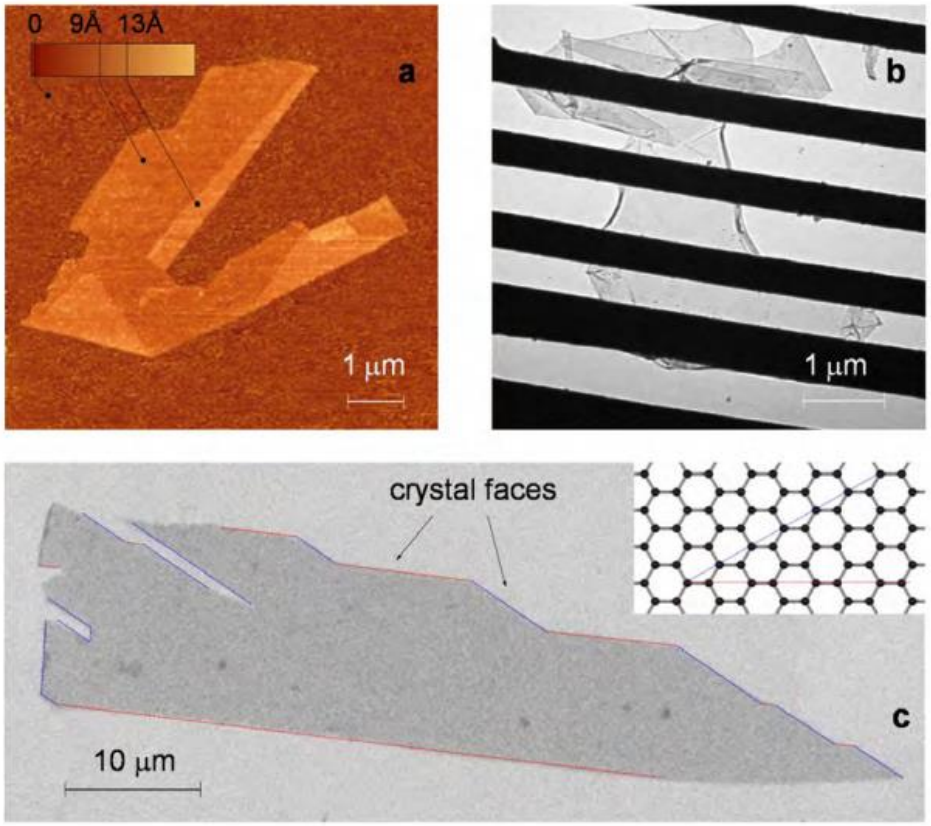
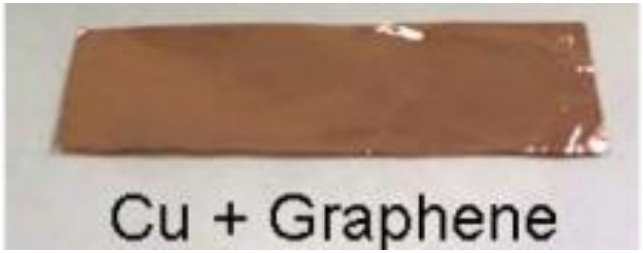


Figure 2. **One-atom-thick single crystals: the thinnest material you will ever see**. **a**, Graphene visualized by atomic-force microscopy (adapted from ref. 8). The folded region exhibiting a relative height of ≈4Å clearly indicates that it is a single layer. **b**, A graphene sheet freely suspended on a micron-size metallic scaffold. The transmission-electron-microscopy image is adapted from ref. 18. **c**, scanning-electron micrograph of a relatively large graphene crystal, which shows that most of the crystal's faces are zigzag and armchair edges as indicated by blue and red lines and illustrated in the inset (*T.J. Booth, K.S.N, P. Blake & A.K.G.* unpublished). 1D transport along zigzag edges and edge-related magnetism are expected to attract significant attention.

Sigma Aldrich 1 cm X 1 cm
singolo strato su supporto di Cu
178 euro



Fullerene C_{60} (98%) 1 g, 161 euro

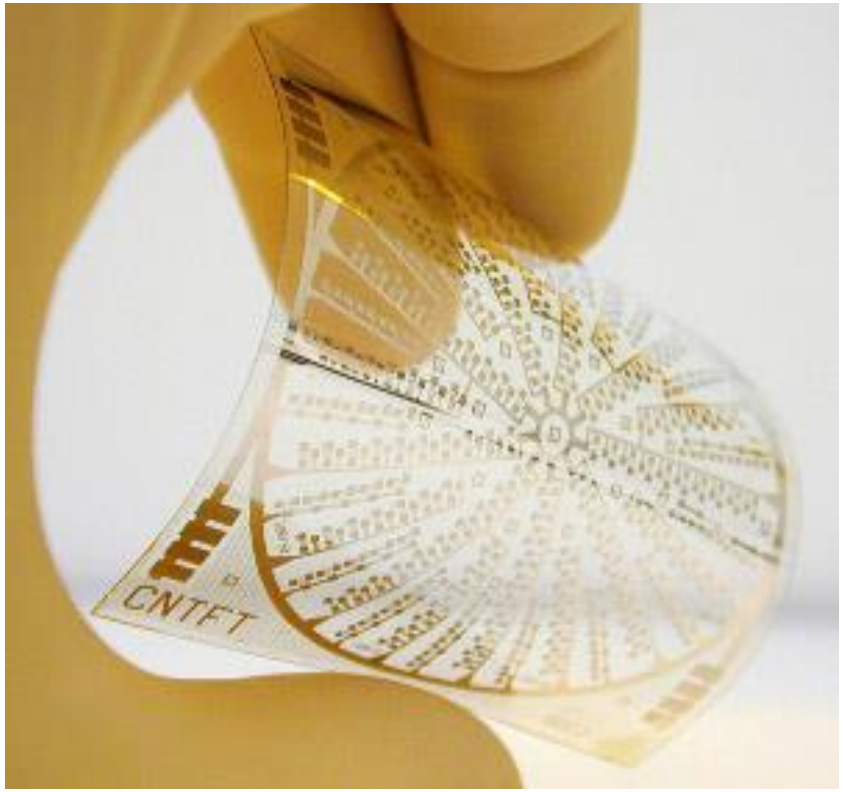
Nanotubi di carbonio SW 250 mg, 290 euro

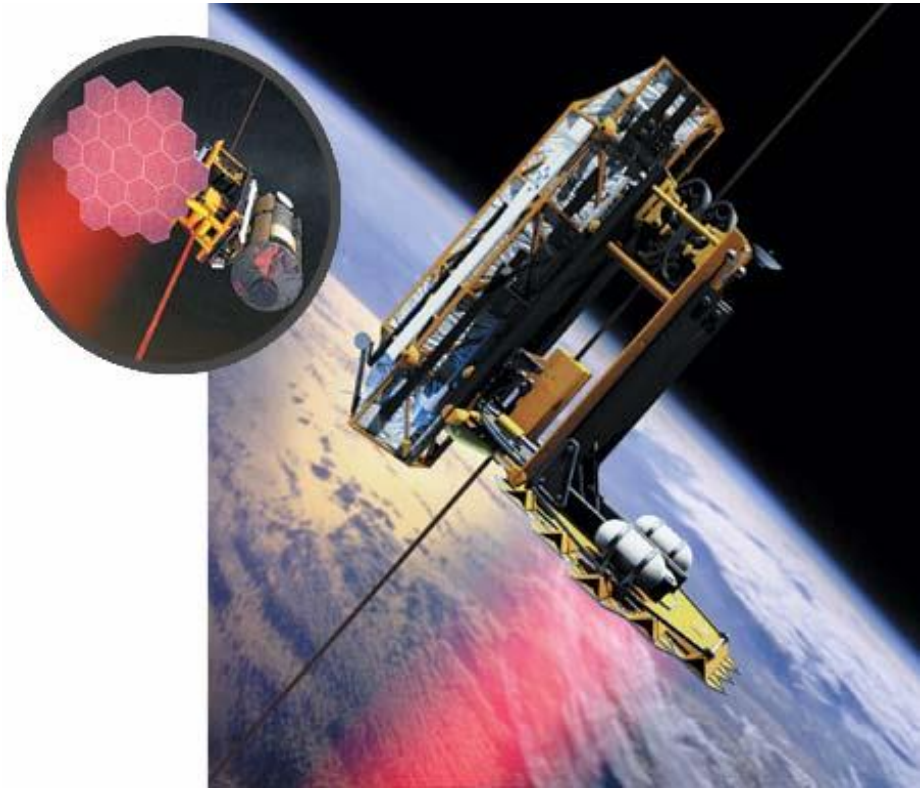
Nanotubi di carbonio MW 25 g, 170 euro

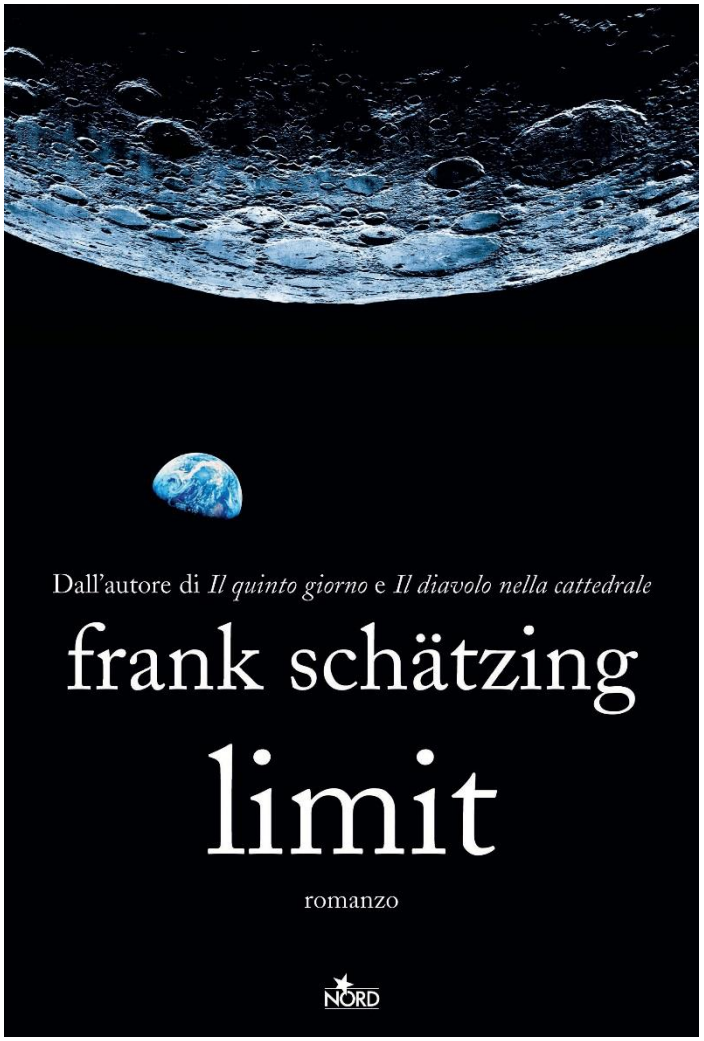
Applicazioni

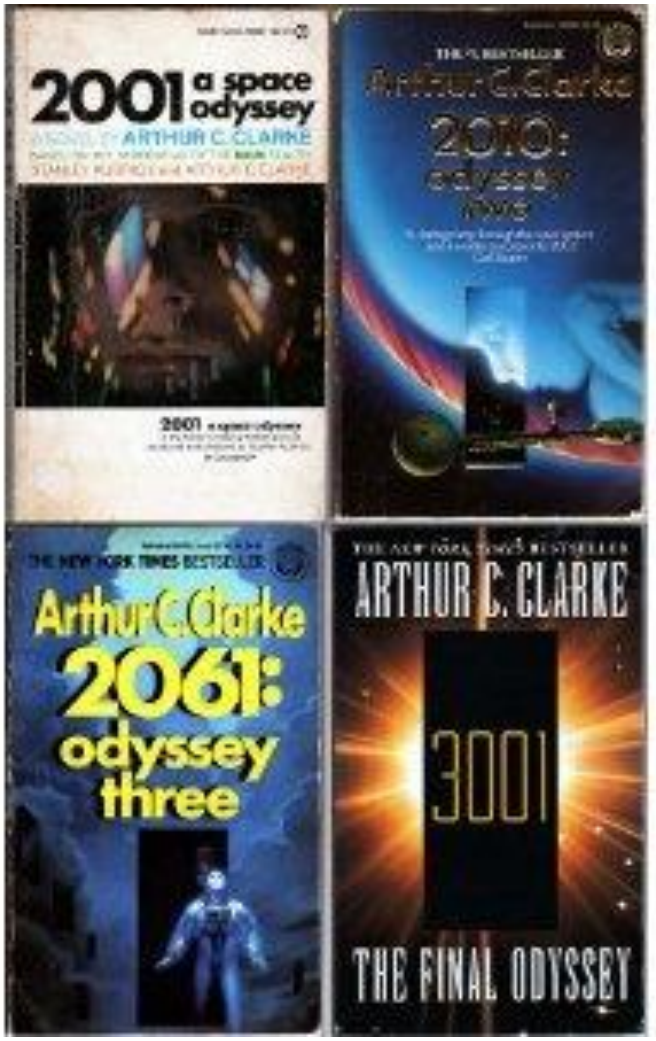
Nanotubi di carbonio

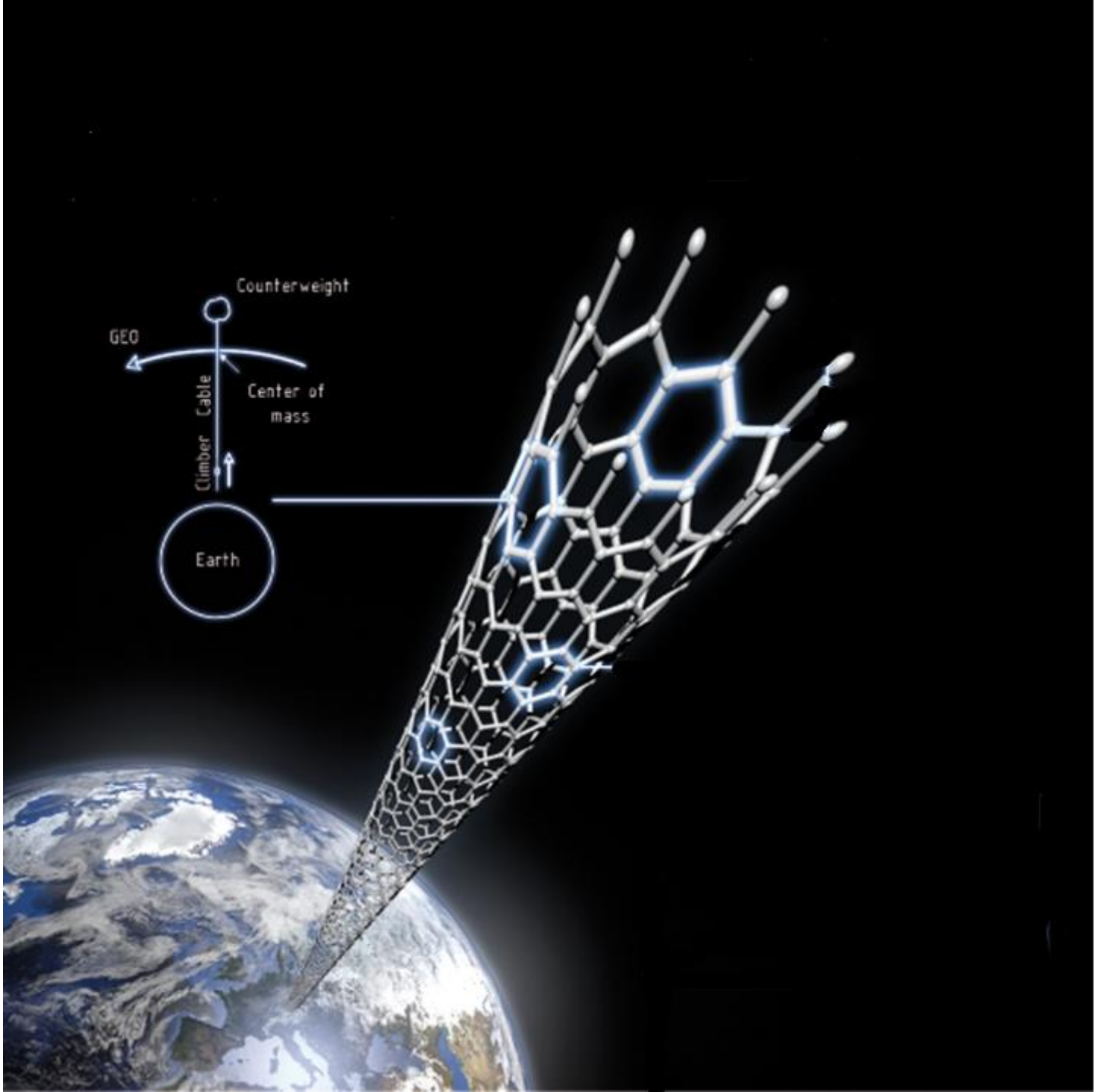
- Meccaniche
  - nanocompositi
  - AFM Tips
- Area superficiale
  - catalisi
  - Hydrogen storage
  - Filtri e membrane
- Elettroniche
  - Elettrodi
  - Sensori
  - Transistor
  - Batterie ioni litio
  - Agenti di contatto in transistor organici
  - Super capacitori
  - Radioricevitore
  - Nanowire


CNTFT

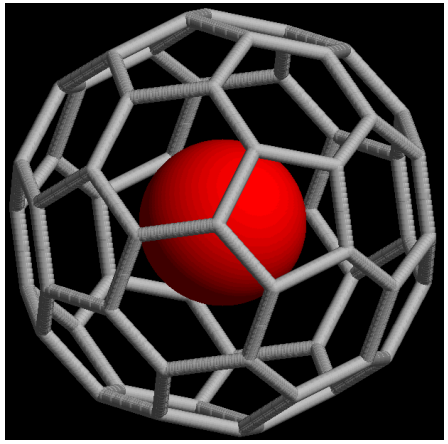


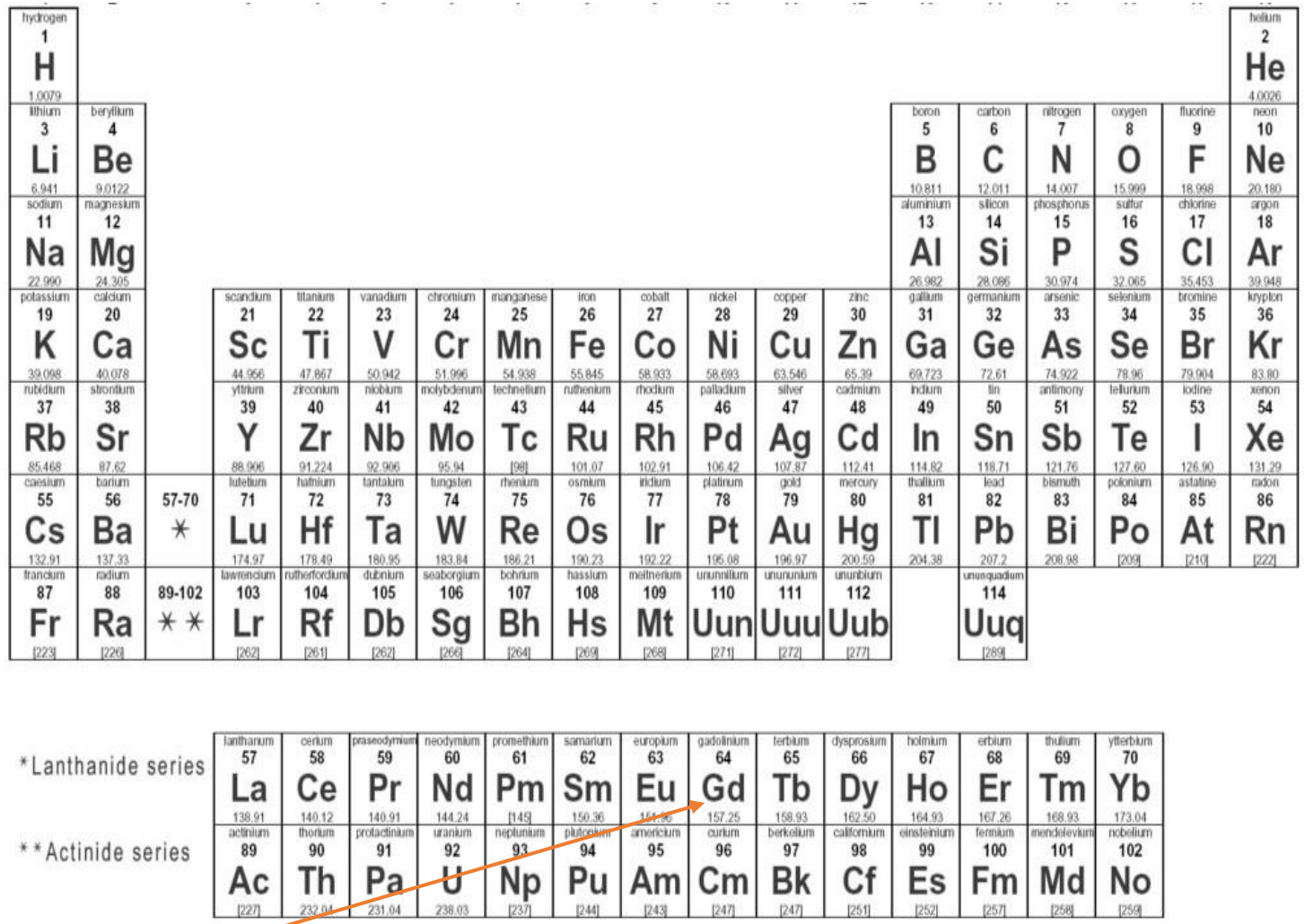

Dall'autore di *Il quinto giorno* e *Il diavolo nella cattedrale*
frank schätzing
limit
romanzo
NORD


2001 a space odyssey
ARTHUR C. CLARKE
Arthur C. Clarke
2010:
odyssey
two
Arthur C. Clarke
2061:
odyssey
three
ARTHUR C. CLARKE
3001
THE FINAL ODYSSEY


Counterweight
GEO
Center of
mass
Climber Cable
Earth

@Fullerene

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lithium 3 Li 6.941
beryllium 4 Be 9.0122
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carbon 6 C 12.011
nitrogen 7 N 14.007
oxygen 8 O 15.999
fluorine 9 F 18.998
neon 10 Ne 20.180
sodium 11 Na 22.990
magnesium 12 Mg 24.305
aluminium 13 Al 26.982
silicon 14 Si 28.086
phosphorus 15 P 30.974
sulfur 16 S 32.065
chlorine 17 Cl 35.453
argon 18 Ar 39.948
potassium 19 K 39.098
calcium 20 Ca 40.078
scandium 21 Sc 44.956
titanium 22 Ti 47.867
vanadium 23 V 50.942
chromium 24 Cr 51.996
manganese 25 Mn 54.938
iron 26 Fe 55.845
cobalt 27 Co 58.933
nickel 28 Ni 58.693
copper 29 Cu 63.546
zinc 30 Zn 65.39
gallium 31 Ga 69.723
germanium 32 Ge 72.61
arsenic 33 As 74.922
selenium 34 Se 78.96
bromine 35 Br 79.904
krypton 36 Kr 83.80
rubidium 37 Rb 85.468
strontium 38 Sr 87.62
yttrium 39 Y 88.906
zirconium 40 Zr 91.224
niobium 41 Nb 92.906
molybdenum 42 Mo 95.94
technetium 43 Tc [98]
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palladium 46 Pd 106.42
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tellurium 52 Te 127.60
iodine 53 I 126.90
xenon 54 Xe 131.29
caesium 55 Cs 132.91
barium 56 Ba 137.33
57-70 *
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hafnium 72 Hf 178.49
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rutherfordium 104 Rf [261]
dubnium 105 Db [262]
seaborgium 106 Sg [266]
bohrium 107 Bh [264]
hassium 108 Hs [269]
meitnerium 109 Mt [268]
ununnilium 110 Uun [271]
unununium 111 Uuu [272]
ununbium 112 Uub [277]
ununquadium 114 Uuq [289]
*Lanthanide series
**Actinide series
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cerium 58 Ce 140.12
praseodymium 59 Pr 140.91
neodymium 60 Nd 144.24
promethium 61 Pm [145]
samarium 62 Sm 150.36
europium 63 Eu 151.96
gadolinium 64 Gd 157.25
terbium 65 Tb 158.93
dysprosium 66 Dy 162.50
holmium 67 Ho 164.93
erbium 68 Er 167.26
thulium 69 Tm 168.93
ytterbium 70 Yb 173.04
actinium 89 Ac [227]
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protactinium 91 Pa 231.04
uranium 92 U 238.03
neptunium 93 Np [237]
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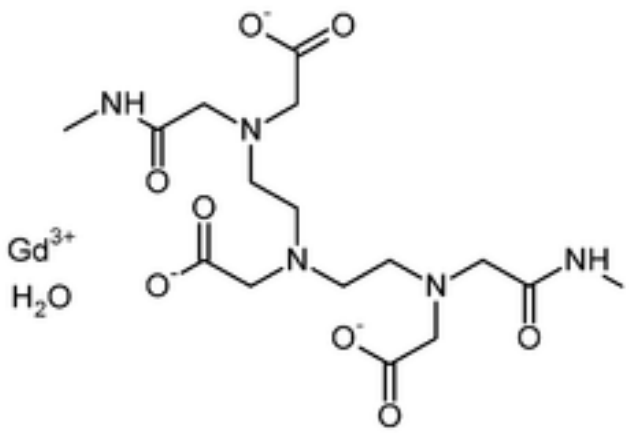
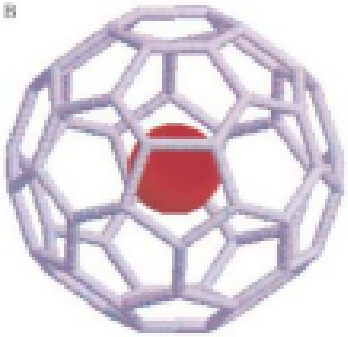
nobelium 102 No [259]


Gd3+
H2O

OMNISCAN™
(gadodiamide) Injection
20 mL
287 mg/mL

Gd@Fullerene



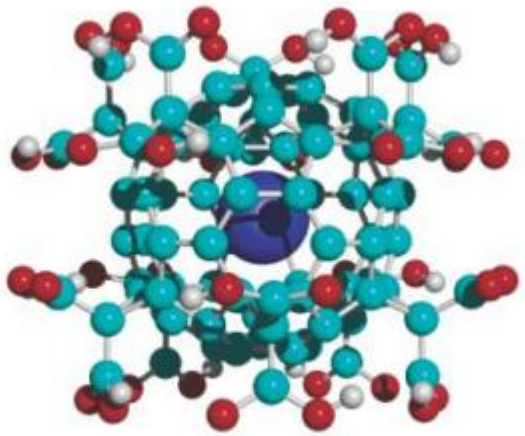
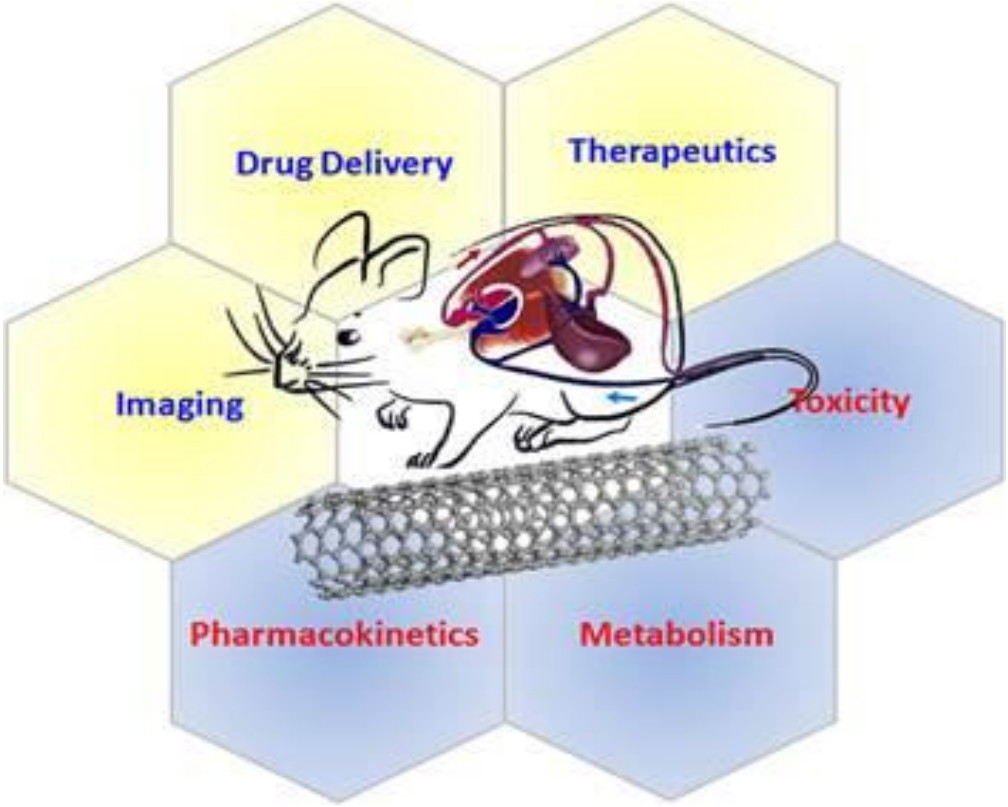
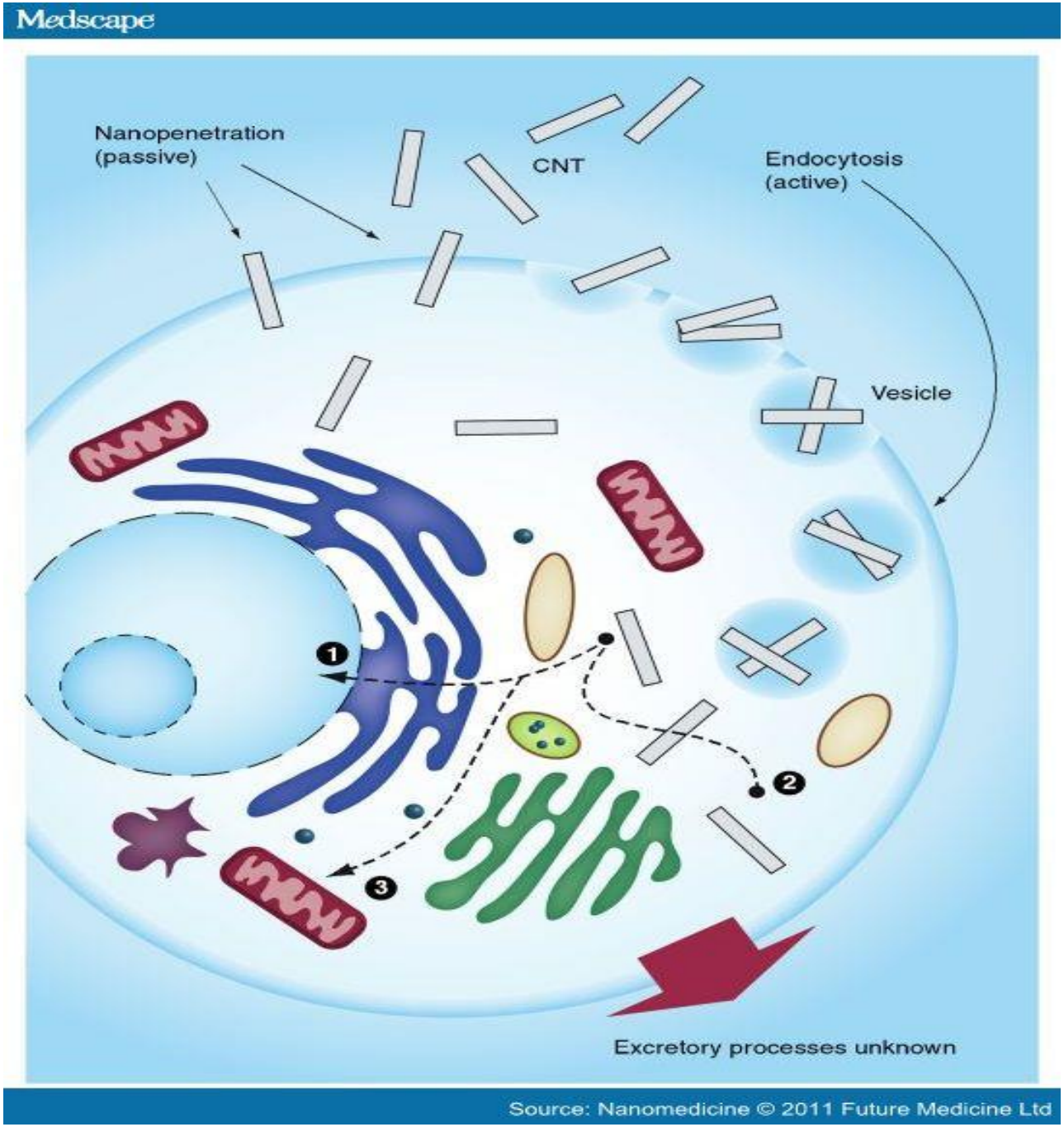
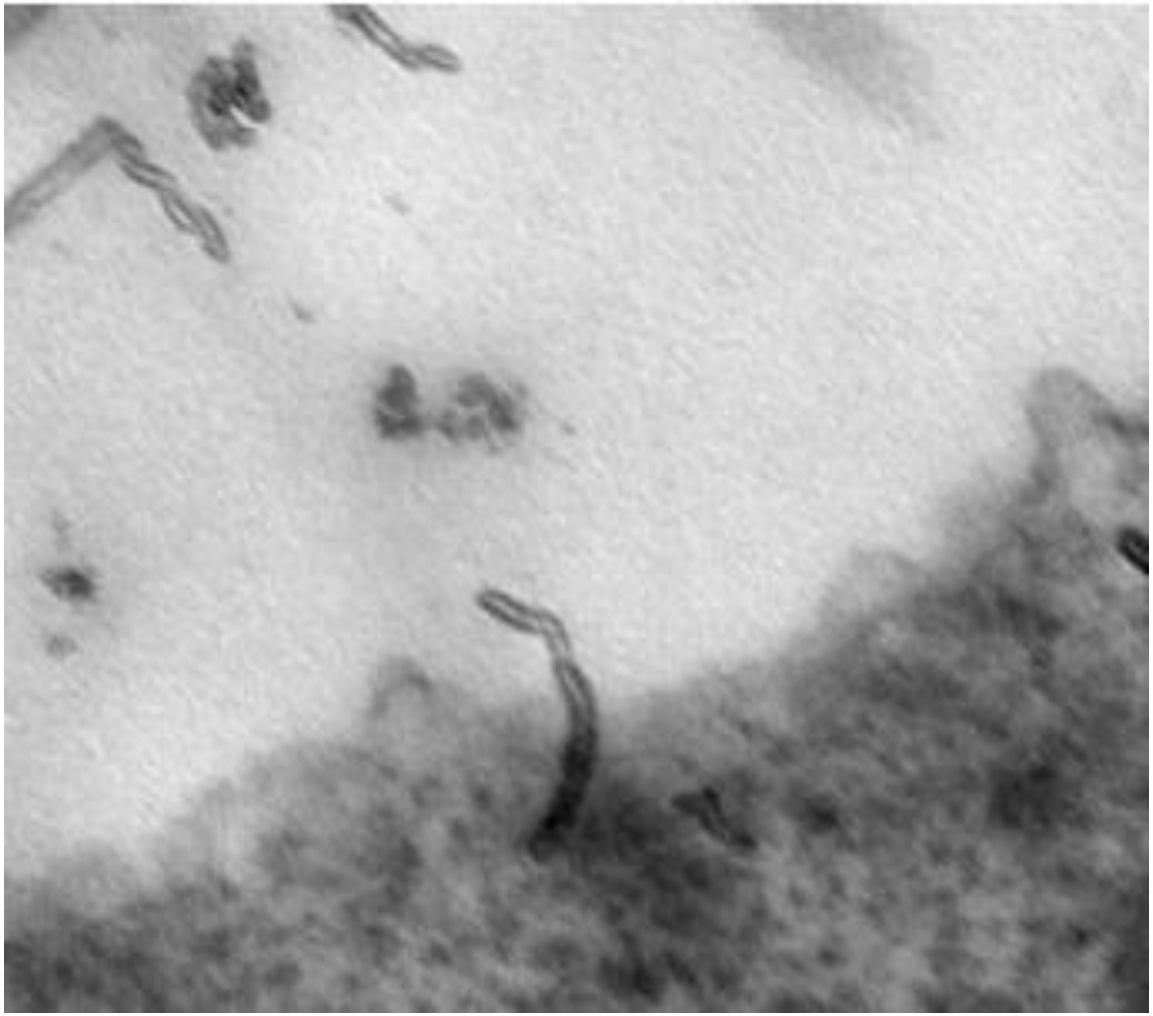


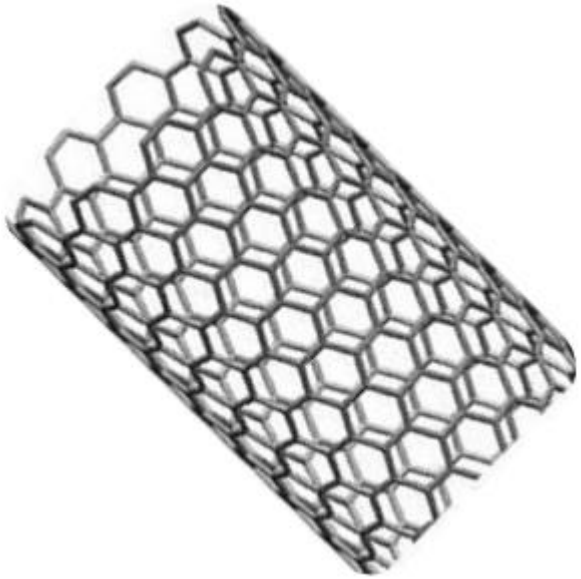
Figure 3. Ball-and-stick depiction of $Gd@C_{60}[C(COOH)_2]_{10}$, illustrating a possible arrangement of 10 $C(COOH)_2$ addends on a single C_{60} cage (light blue, C; red, O; white, H; dark blue, Gd).

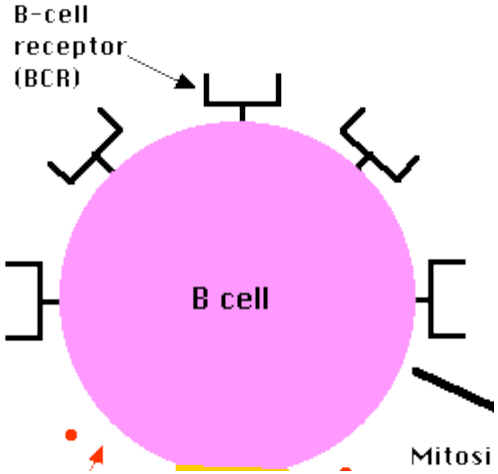
Nanoaghi?

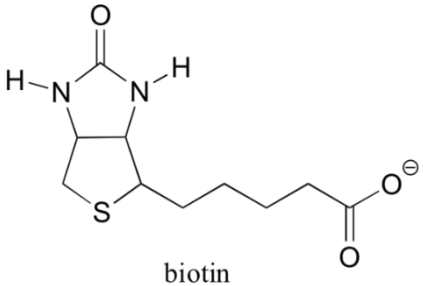

Drug Delivery
Therapeutics
Imaging
Toxicity
Pharmacokinetics
Metabolism


Medscape
Nanopenetration
(passive)
CNT
Endocytosis
(active)
Vesicle
1
2
3
Excretory processes unknown
Source: Nanomedicine © 2011 Future Medicine Ltd

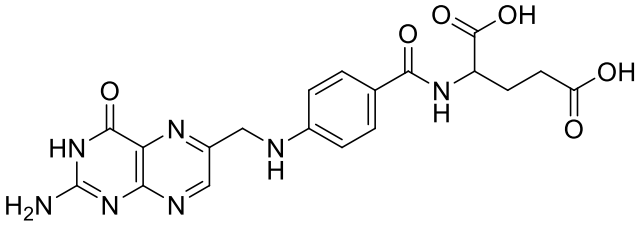




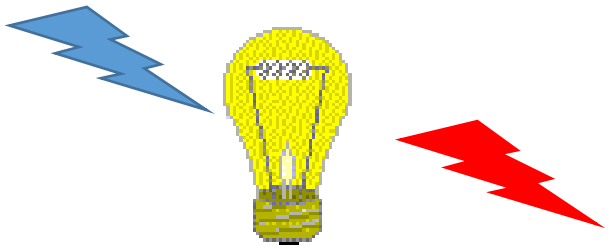


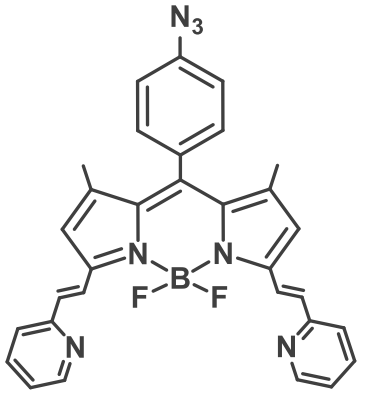


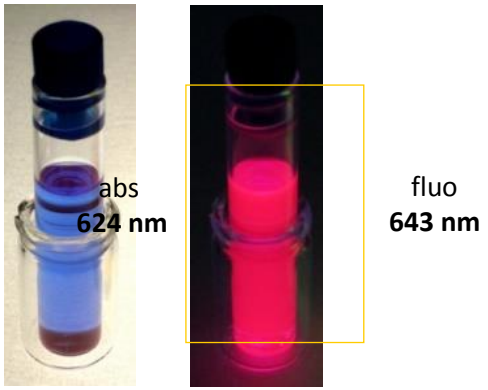
biotin

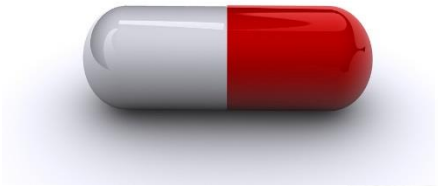


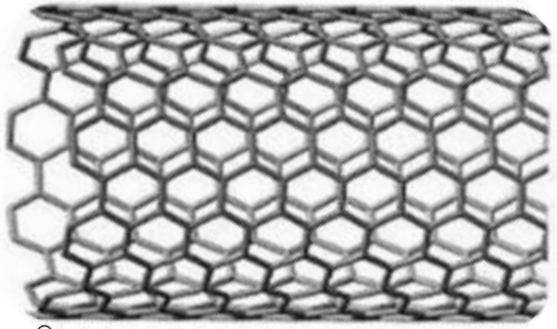
folic acid

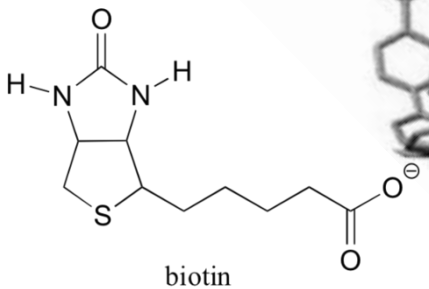



N3
N
B
F
F
N
N
N

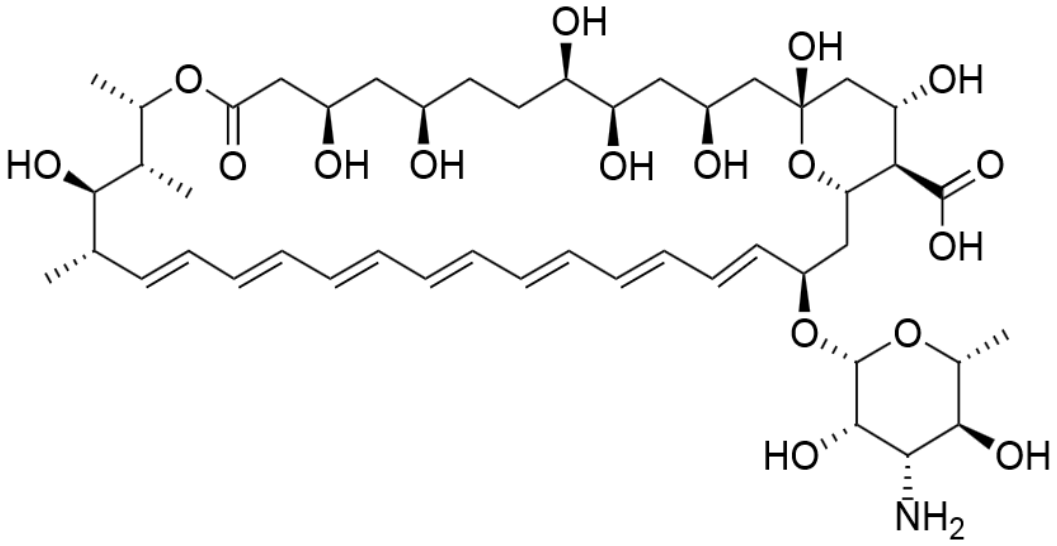

abs
624 nm
fluo
643 nm



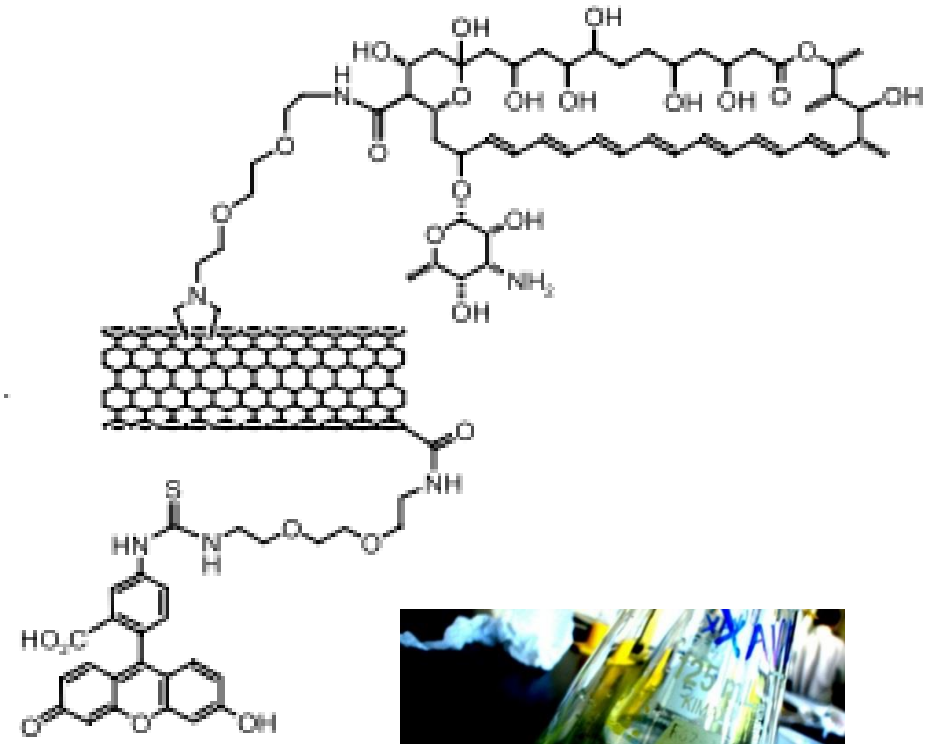




biotin

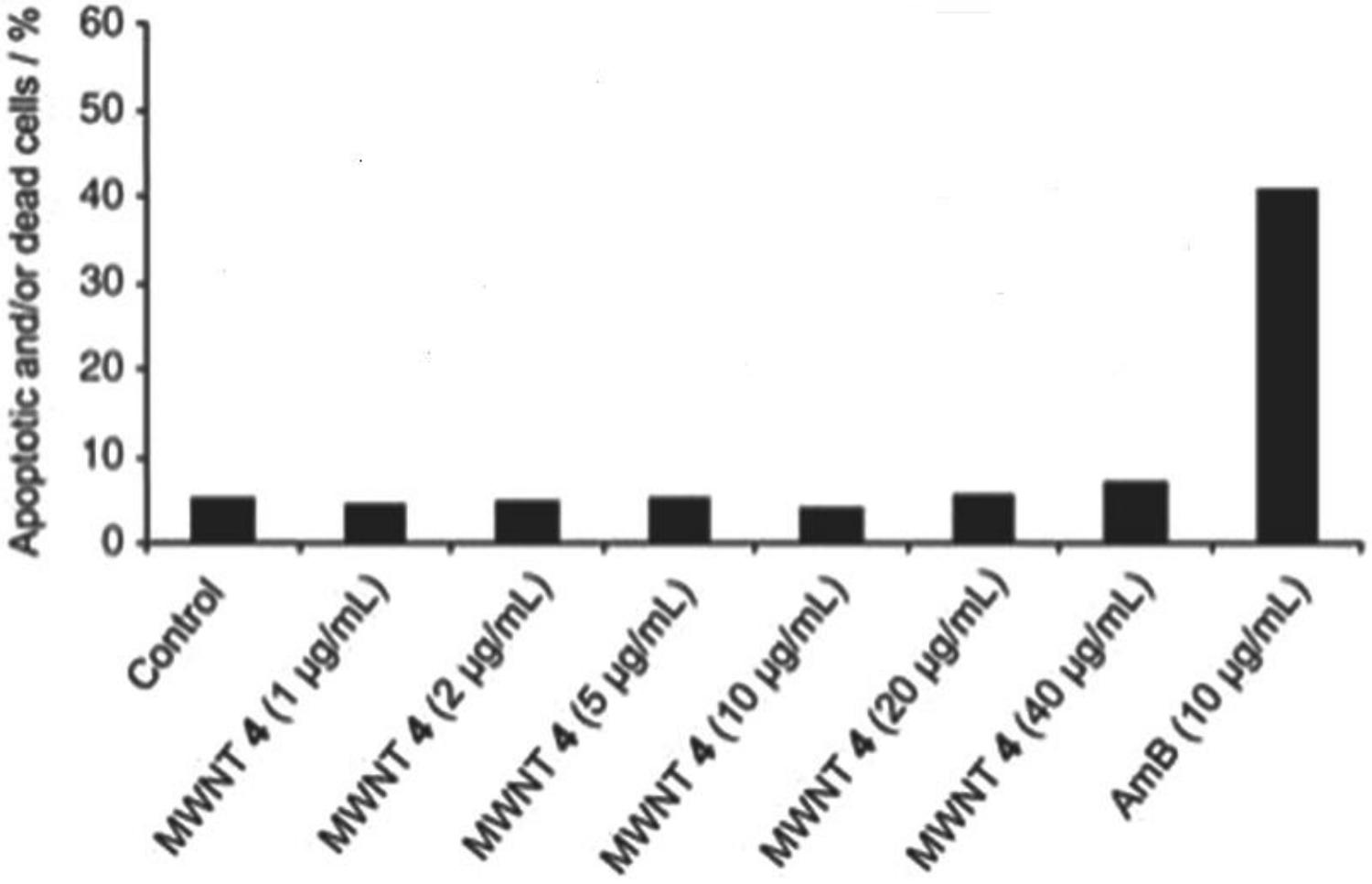


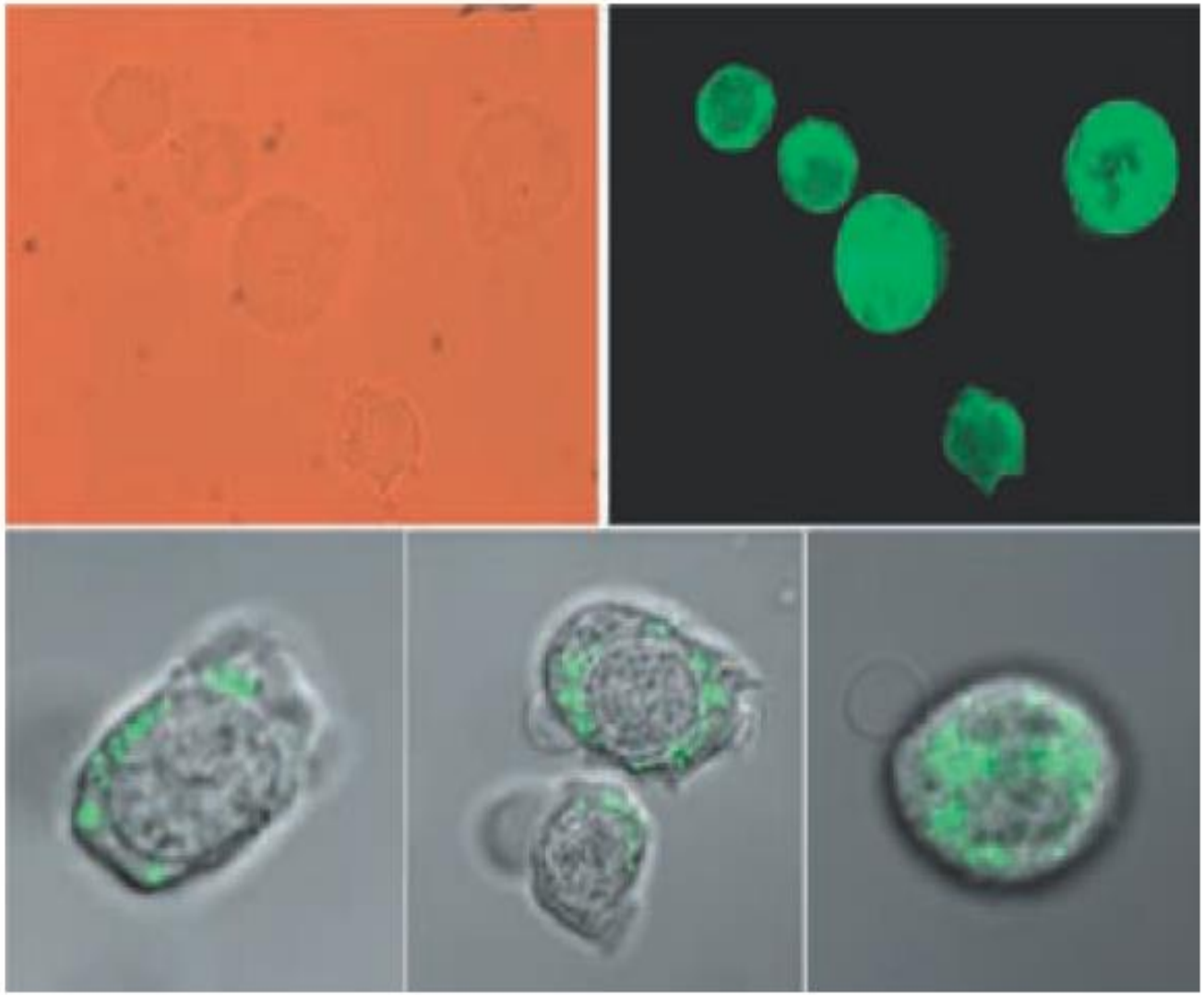
Amfotericina B

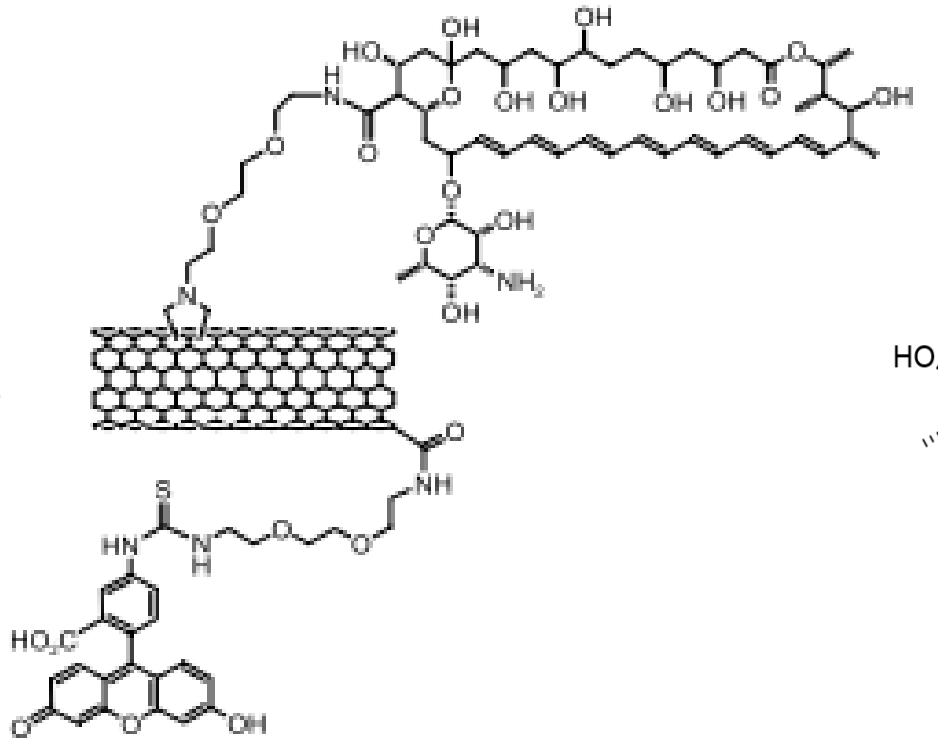


FLUORESCEINA 10% POEN
FLUORESCEINA SODICA 10%
INYECTABLE
Para inyección intravenosa
Poen

Tossicità verso cellule umane







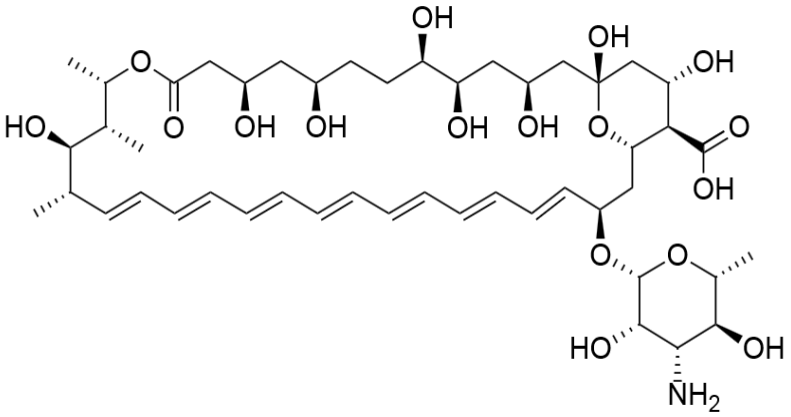


Table 2: Antifungal activity of CNT–AmB conjugates.

CNT	Minimum inhibitory concentration (MIC)[a] [μg mL]$^{-1}$ *C. parapsilosis* ATCC 90118	*C. albicans* (c.i.)[b]	*C. neoformans* ATCC 90112
AmB	20	>80	5
SWNT–NH_3^+	>80	>80	>80
MWNT–AmB[c] **18**	1.6	6.4	0.8
SWNT–AmB[c] **19**	1.6	13.8	0.8

ACCOUNTS
of chemical research

Oh, the Places You'll Go with Graphene

JONATHAN K. WASSEI[†] AND RICHARD B. KANER[*,†,‡]

[†]Department of Chemistry & Biochemistry and California Nano Systems Institute, University of California, Los Angeles, California, 90095, United States, and
[‡]Department of Materials Science and Engineering and California Nano Systems Institute, University of California, Los Angeles, California, 90095, United States

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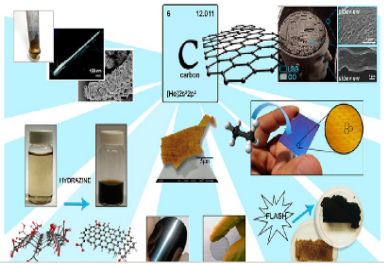
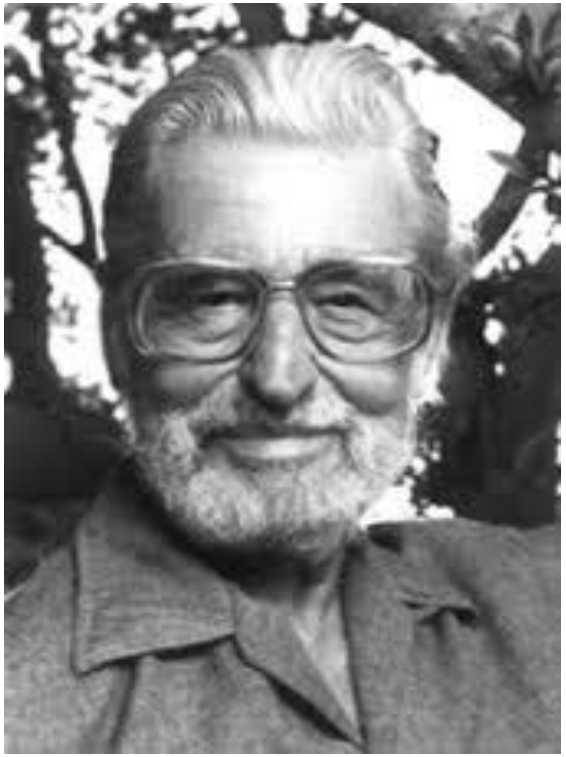
CONSPECTUS



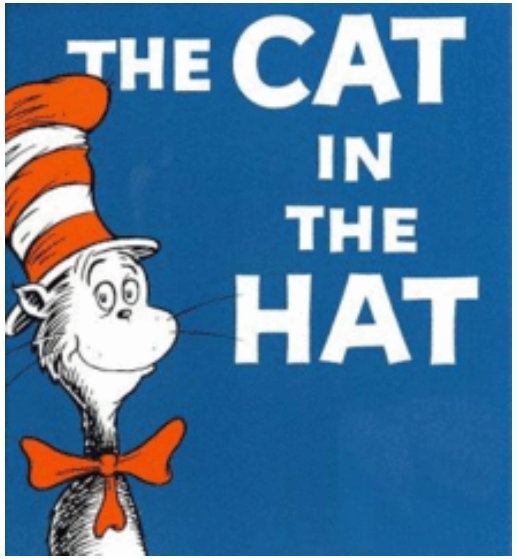


Dr. Seuss

- **OH, THE PLACES YOU'LL SEE!**

- Congratulations!
- Today is your day.
- You're off to Great Places!
- You're off and away!
-
- You have brains in your head.
- You have feet in your shoes.
- You can steer yourself
- any direction you choose.
- You're on your own. And you know what you know.
- And YOU are the guy who'll decide where to go.

- **And will you succeed?**
- **Yes! You will, indeed!**
- **(98 and 3/4 percent guaranteed.)**



In bocca al lupo !

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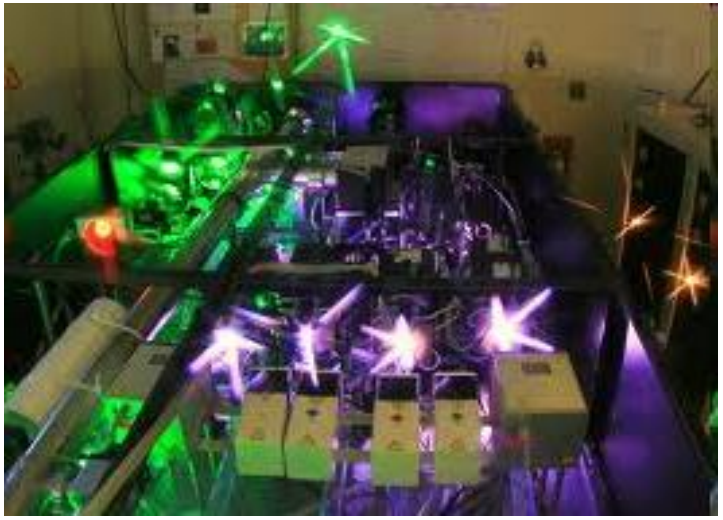
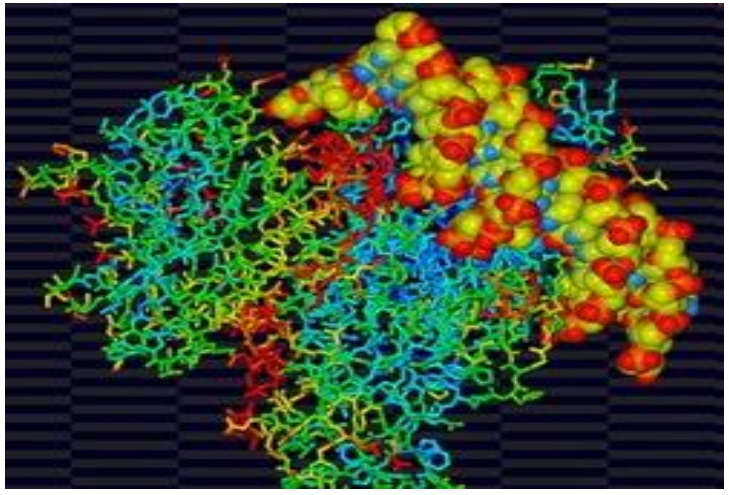


CHIMICA



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Tecnologie Chimiche

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Chimica supramolecolare dei materiali e dei nanosistemi

Chimica dell'ambiente e dei beni culturali

Chimica delle molecole biologiche

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Possibilità di Erasmus presso molte sedi europee

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  - ***Industria chimica e farmaceutica***
  - ***Laboratori di ricerca/analisi pubblici e privati***
  - ***Libera professione***
  - ***Scuola***

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