

Nanotechnologie v praxi

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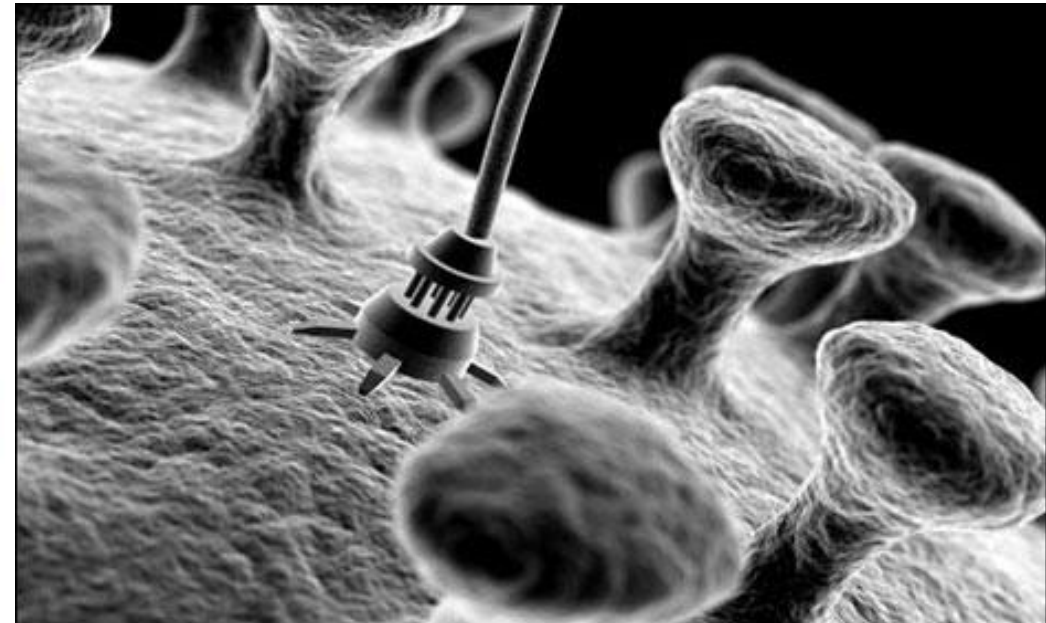
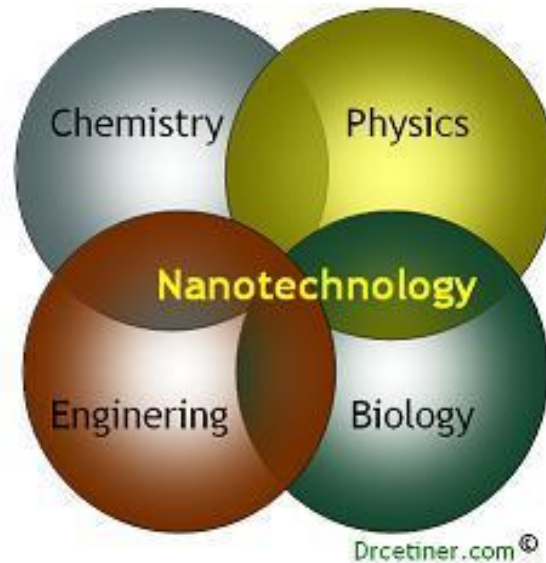


Obsah

- Úvod a historie nanotechnologií
- Nanotechnologie v praxi a jejich aplikace
- Nanomateriály
- Nanoskopy a mikroskopy
- Výroba nanostruktur a jejich vlastnosti
- Budoucnost nanotechnologií

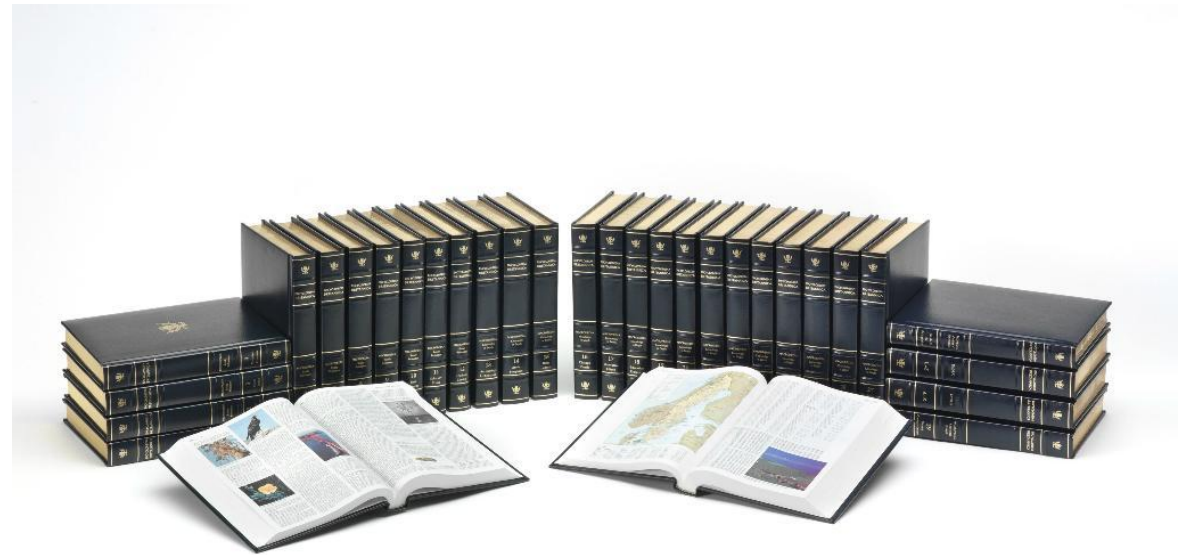
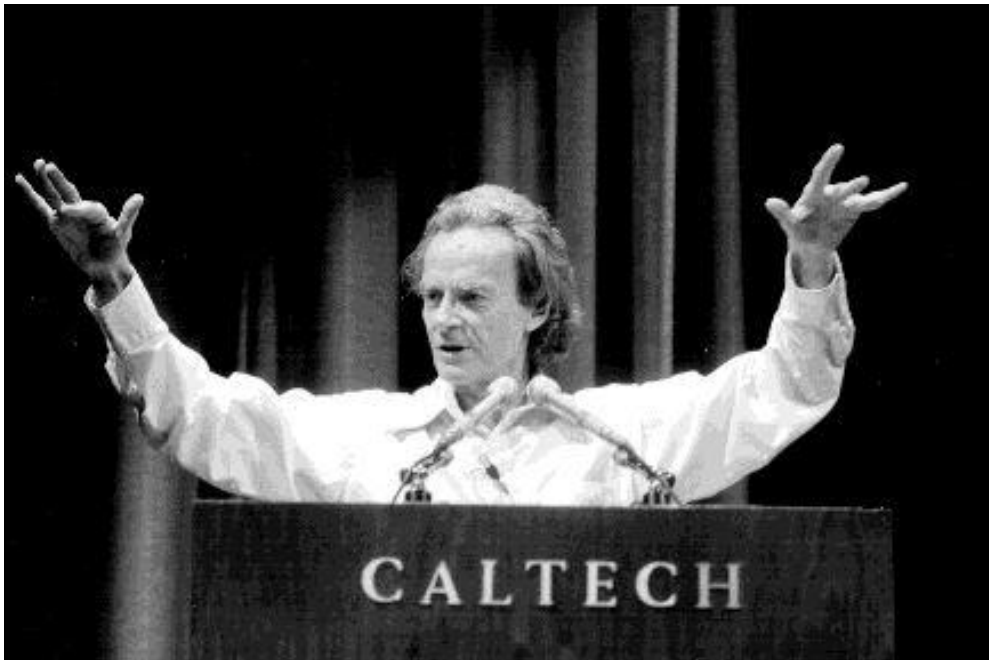
Nanotechnologie

- Nano - předpona 0,000 000 001 (10^{-9})
- Technologie – tvorba a zdokonalování výrobních procesů



Tam dole je spousta místa

- Richard Feynman (29. 12. 1959) *“There’s Plenty of Room at the Bottom”*



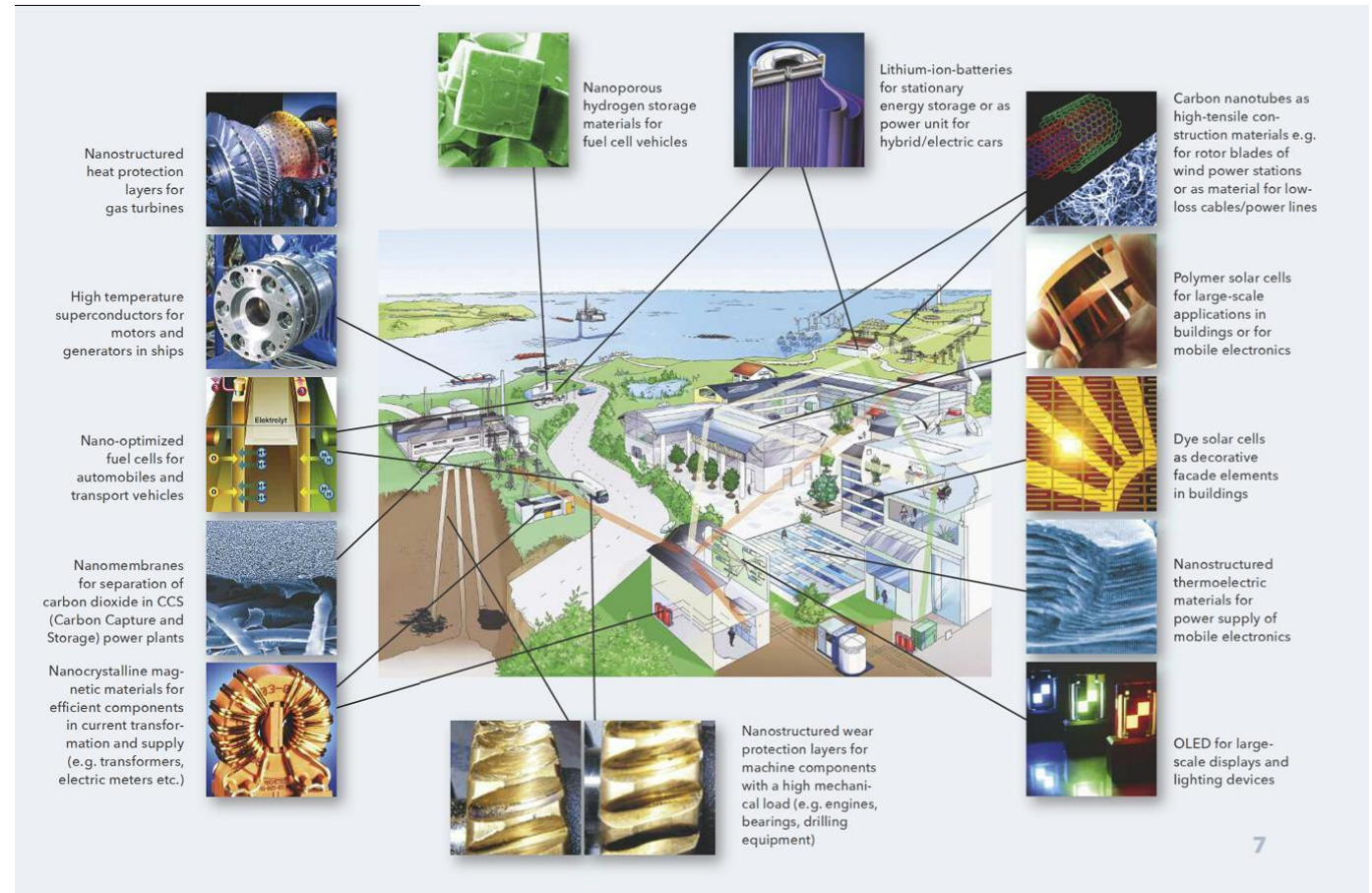
„Proč bychom nemohli zapsat na špendlíkovou
hlavičku všech 24 dílů Encyklopedie Britanniky?“.

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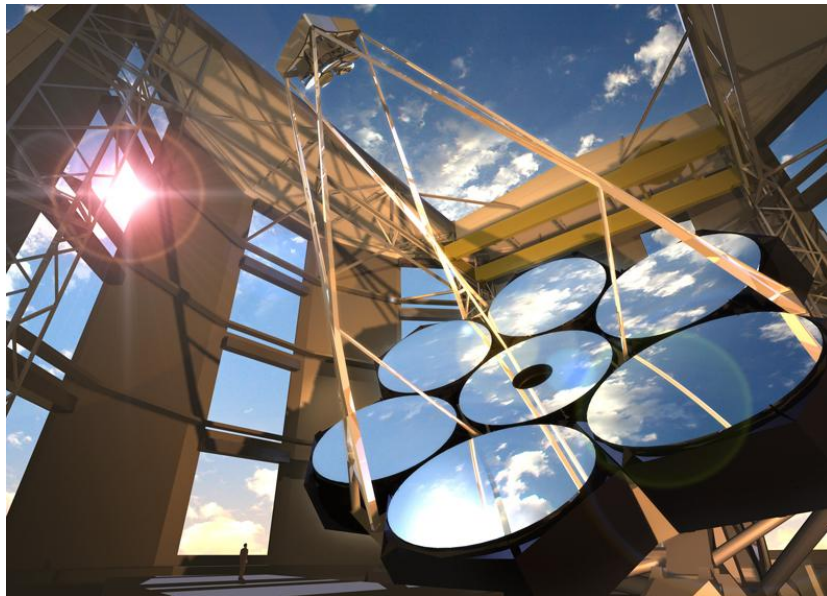
Využití nanotechnologií

- Elektronika
- Zdravotnictví
- Strojírenství
- Stavebnictví
- Chemický průmysl
- Textilní průmysl
- Optický průmysl
- Automobilový průmysl
- Energetika
- Ochrana prostředí
- **Astronomie**



Nanotechnologie v astronomii

- Iontové leštění a pokovování zrcadel, adaptivní optika
- Kosmonautika - materiálový výzkum, vakuová a raketová technika
- IT technika a numerické simulace
- Mikroskopické a spektroskopické metody, CCD detektory



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Substrát

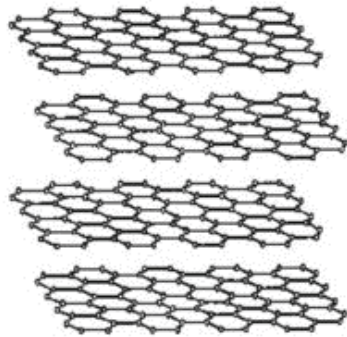


1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
I A	II A	III B	IV B	V B	VI B	VII B	VIII	VIII	VIII	I B	II B	III A	IV A	V A	VI A	VII A	0	
Vodík 1 H 1,00794(7)																	Helium 2 He 4,002602(2)	
Lithium 3 Li 6,941(2)	Beryllium 4 Be 9,012182(3)																	Neon 10 Ne 20,1797(8)
Sodík 11 Na 22,989770(2)	Hořálek 12 Mg 24,3050(6)																	Argon 18 Ar 39,948(1)
Draslík 19 K 39,0983(1)	Vápník 20 Ca 40,078(4)	Skandium 21 Sc 44,955910(8)	Titan 22 Ti 47,867(1)	Vanad 23 V 50,9415(1)	Chrom 24 Cr 51,9961(8)	Mangan 25 Mn 54,938045(9)	Železo 26 Fe 55,845(2)	Kobalt 27 Co 58,933200(9)	Nikl 28 Ni 58,6934(2)	Měď 29 Cu 63,546(3)	Zinek 30 Zn 65,39(2)	Gallium 31 Ga 69,723(1)	Germanium 32 Ge 72,61(2)	Arsen 33 As 74,92160(2)	Selen 34 Se 78,96(3)	Brom 35 Br 79,904(1)	Krypton 36 Kr 83,80(1)	
Rubidium 37 Rb 85,4678(3)	Stroncium 38 Sr 87,62(1)	Yttrium 39 Y 88,90585(2)	Zirkonium 40 Zr 91,224(2)	Niob 41 Nb 92,90638(2)	Molybden 42 Mo 95,94(1)	Technecium 43 Tc (98,9063)	Ruthenium 44 Ru 101,07(2)	Rhodium 45 Rh 102,90550(2)	Palladium 46 Pd 106,42(1)	Sířič 47 Ag 107,8682(2)	Kadmium 48 Cd 112,411(8)	Indium 49 In 114,818(3)	Cín 50 Sn 118,710(7)	Antimon 51 Sb 121,760(1)	Tellur 52 Te 127,60(3)	Jod 53 I 126,90447(3)	Xenon 54 Xe 131,29(2)	
Ceolium 55 Cs 132,90545(2)	Baryum 56 Ba 137,327(7)	57-70 Lantha- noidy		Hafnium 72 Hf 178,49(2)	Tantal 73 Ta 180,9479(1)	Wolfram 74 W 183,84(1)	Rhenium 75 Re 186,207(1)	Osmium 76 Os 190,23(3)	Iridium 77 Ir 192,217(3)	Platina 78 Pt 195,078(2)	Zlato 79 Au 196,96655(2)	Rtut 80 Hg 200,59(2)	Thallium 81 Tl 204,3833(2)	Olovo 82 Pb 207,2(1)	Bismut 83 Bi 208,98039(2)	Polonium 84 Po (209,9824)	Astat 85 At (209,9871)	Radon 86 Rn (222,0176)
Francium 87 Fr (223,0187)	Rádium 88 Ra (226,0254)	89-102 Akti- noidy		Rutherfordium 104 Rf (261,110)	Dubnium 105 Db (262,1144)	Seaborgium 106 Sg (263,1168)	Bohrrium 107 Bh (264,12)	Hassium 108 Hs (265,1306)	Melitrium 109 Mt (268)	Ununium 110 Uun (269)	Ununium 111 Uuu (272)	Ununium 112 Uub (277)						

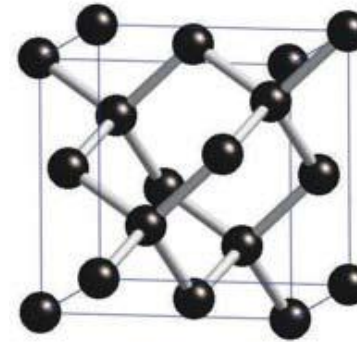
Grafén



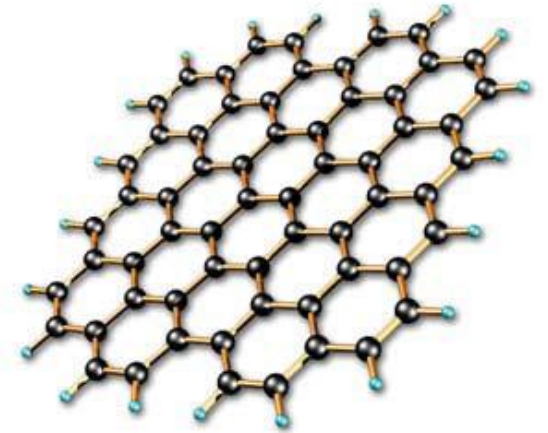
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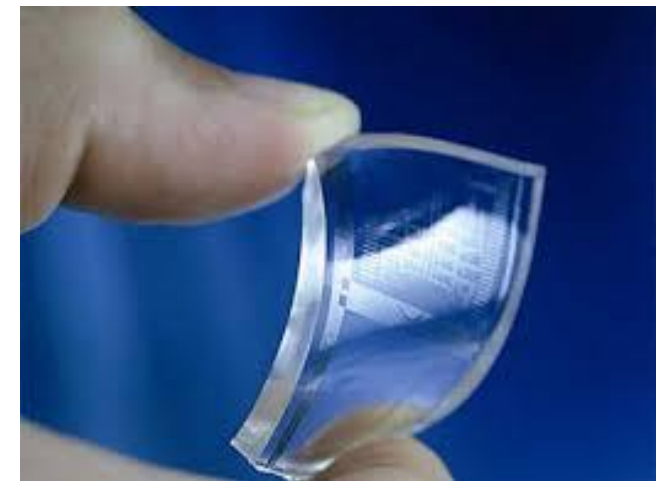
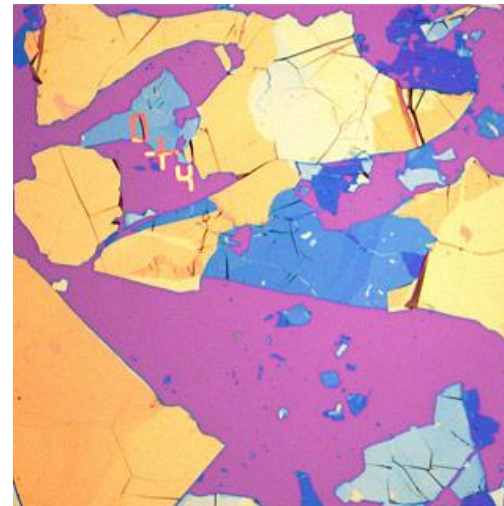
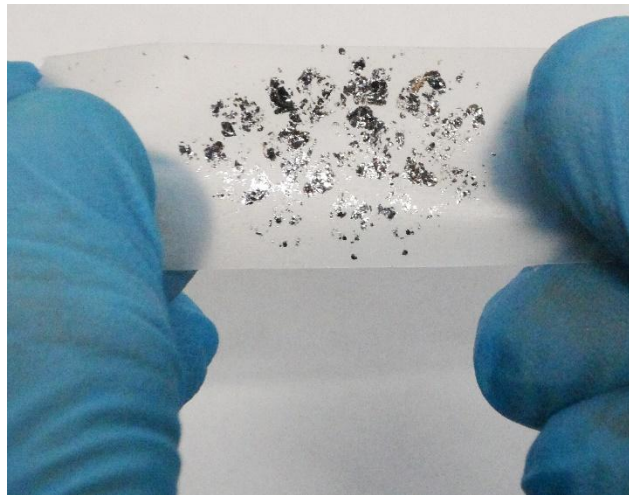
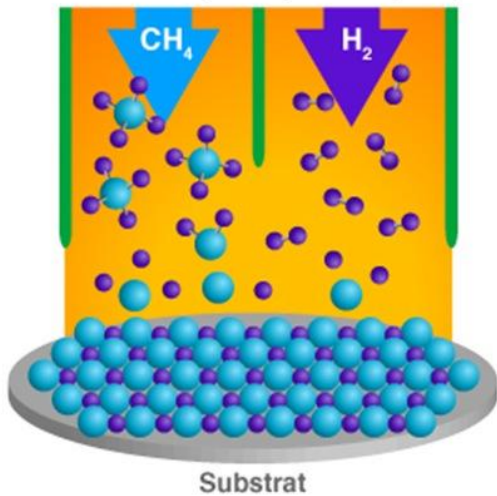
Diamant



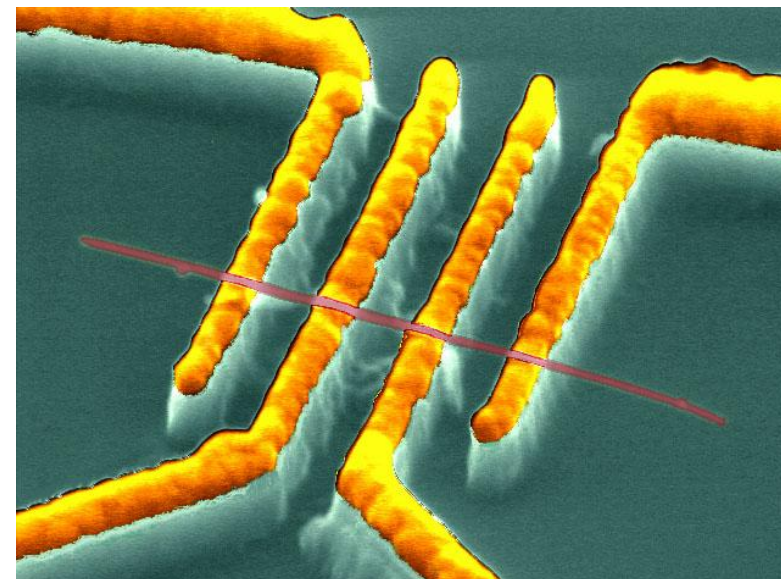
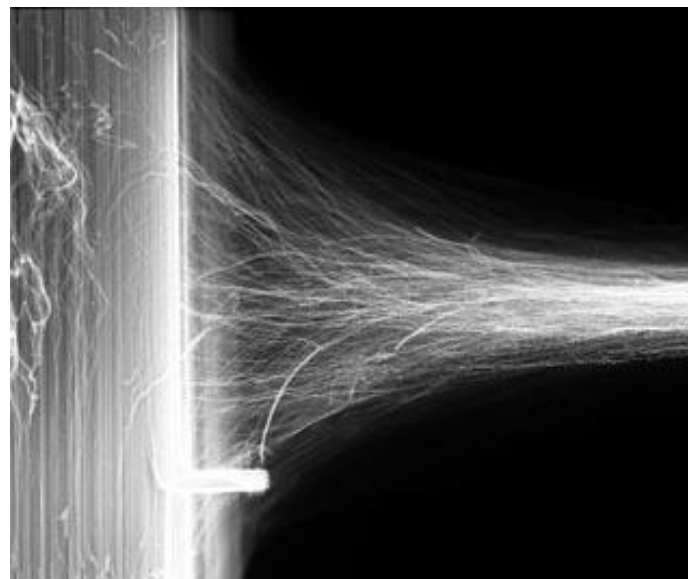
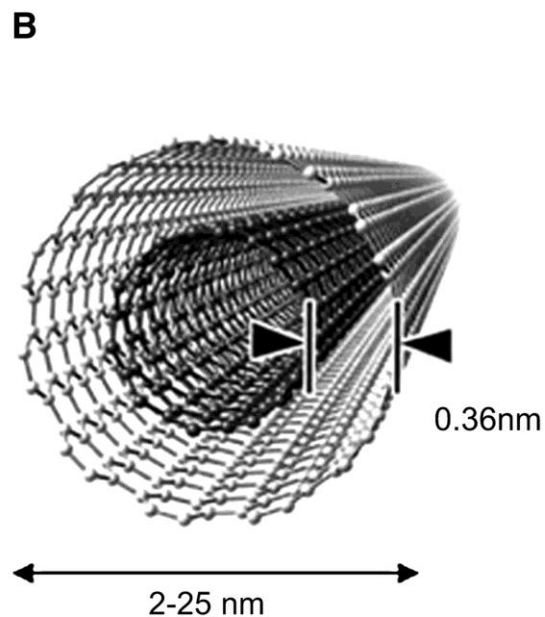
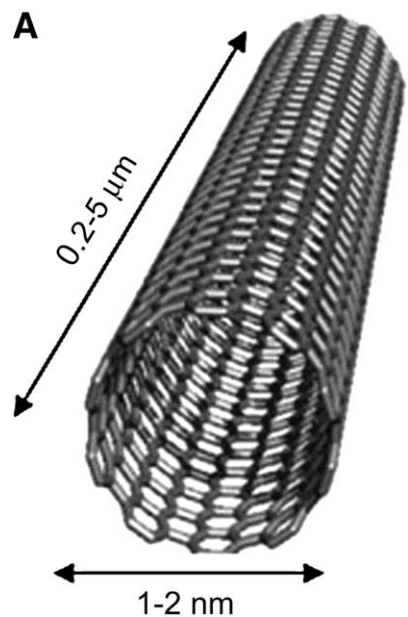
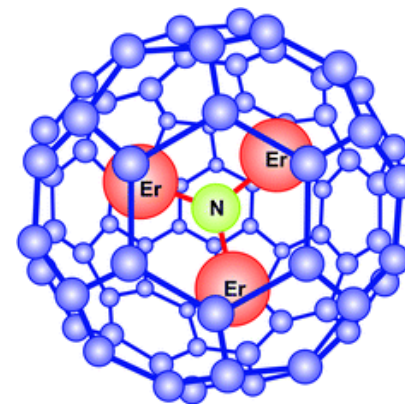
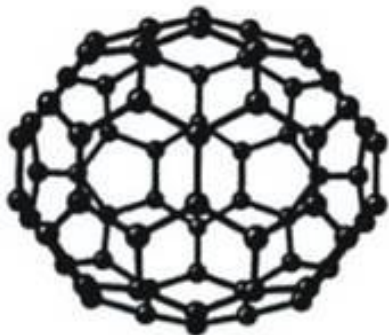
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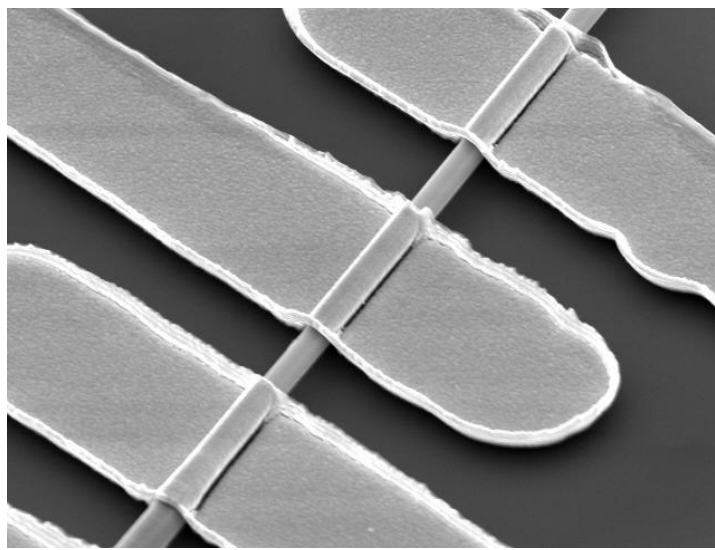
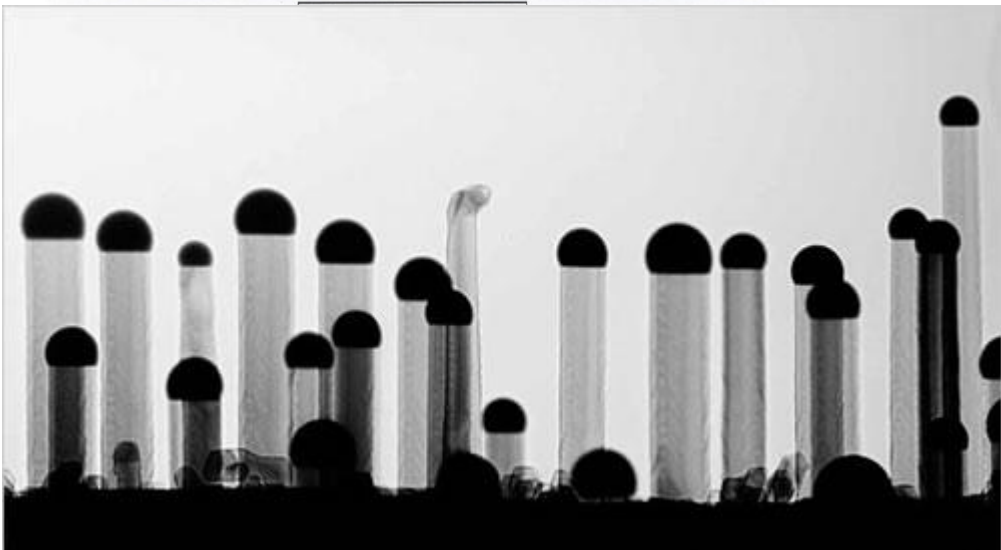
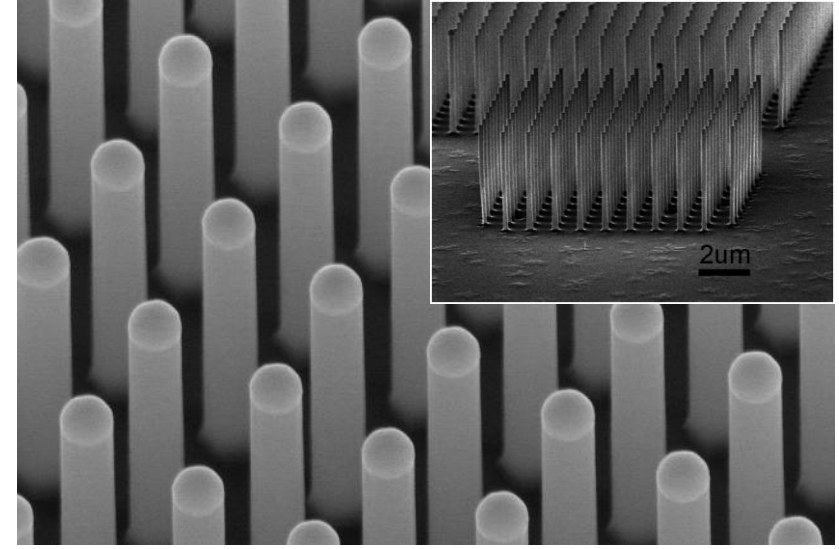
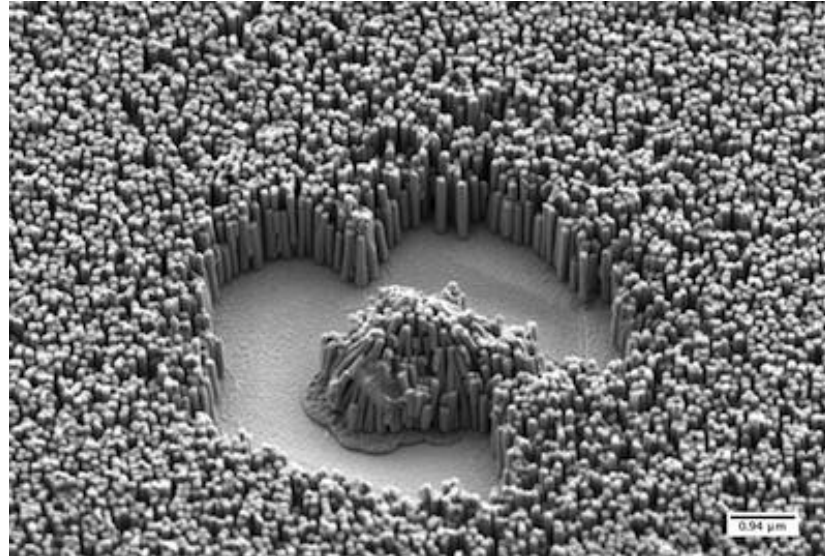
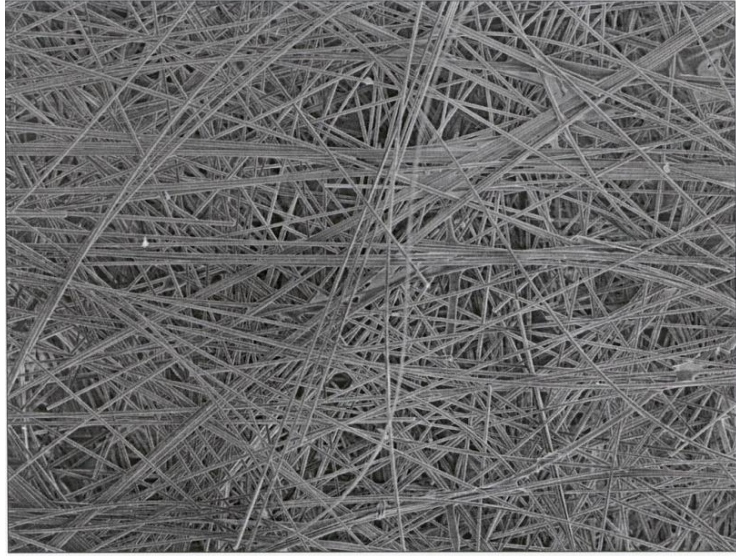
Chemical Vapor Deposition (CVD)



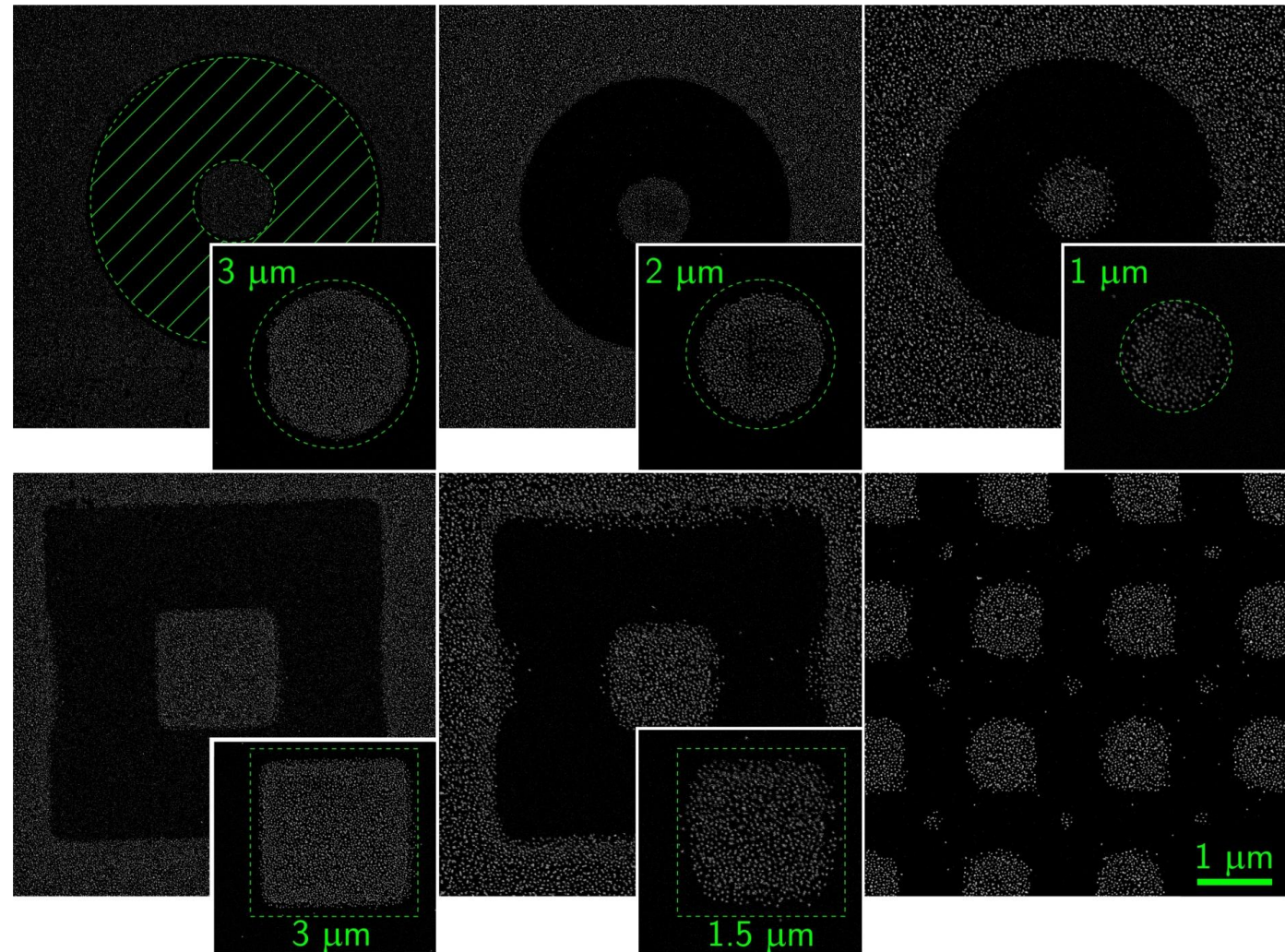
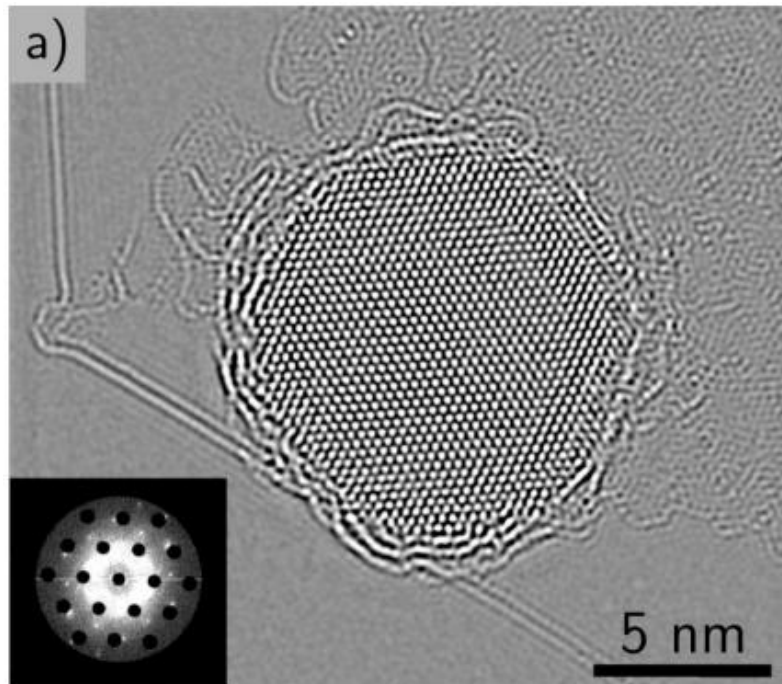
Fulleren & Nanotubes



Nanodrátý



Koloidní roztoky

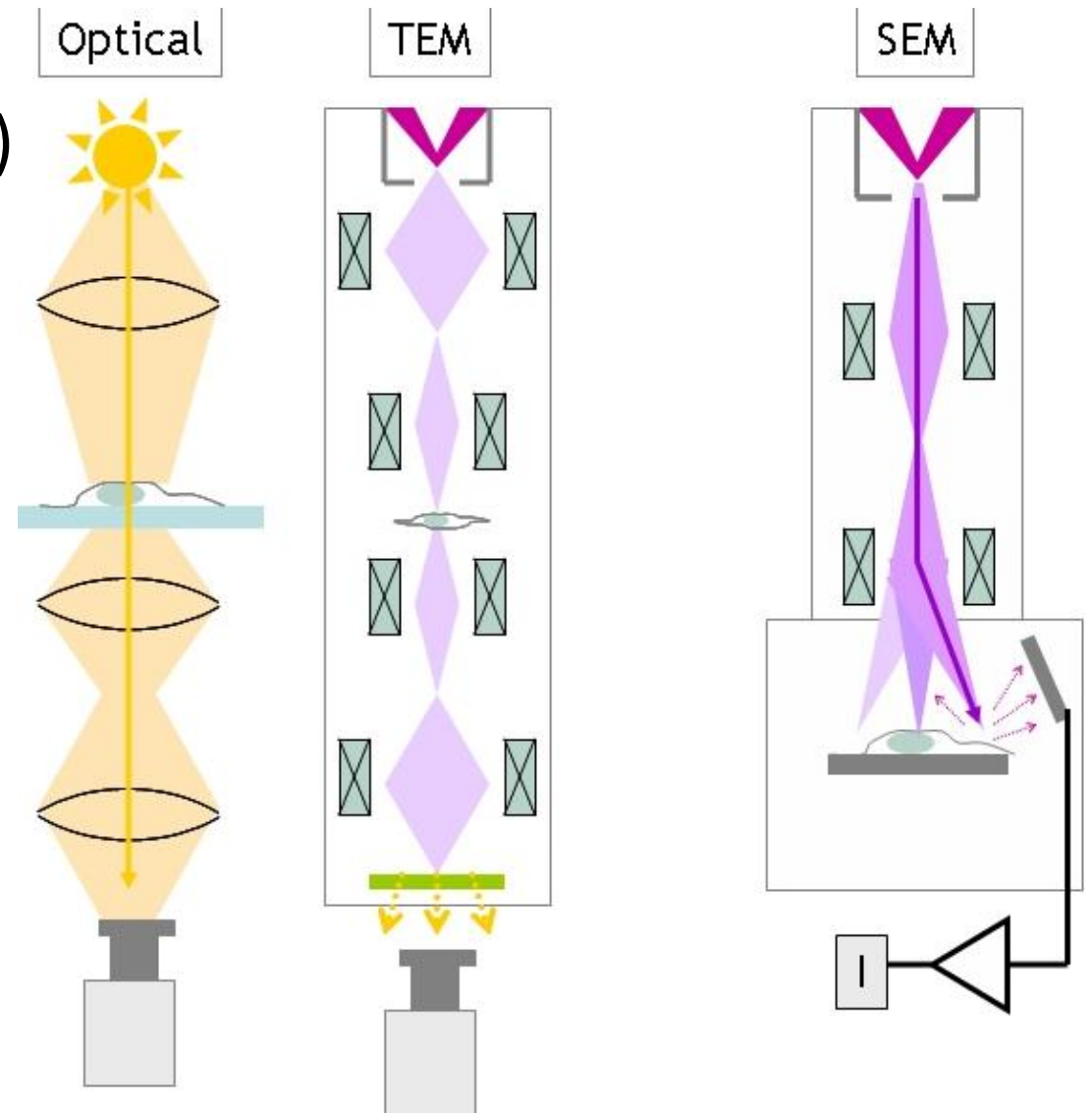
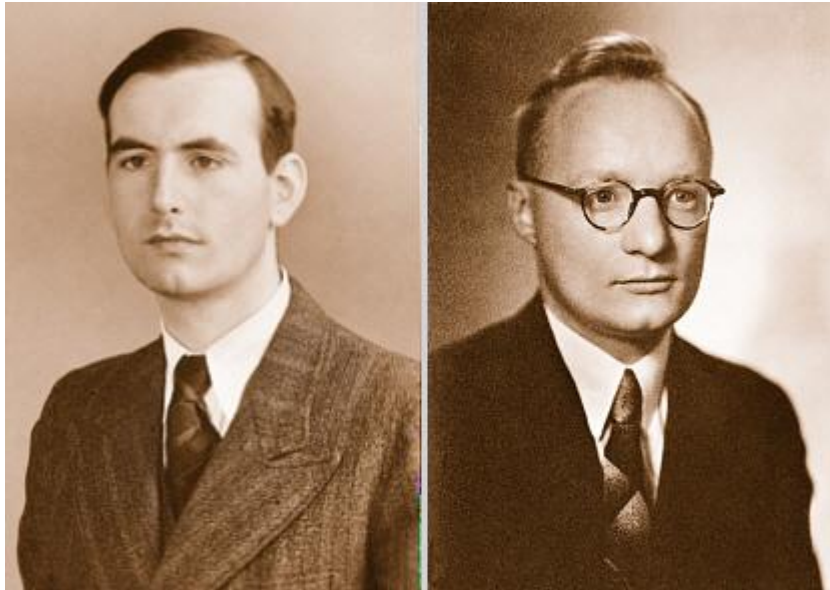


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Mikroskopy a Nanoskopy

- Elektronový mikroskop (1931 – 1933)
- Ernst Ruska, Max Knoll



Mikroskopy a Nanoskopy



Tescan BS 242



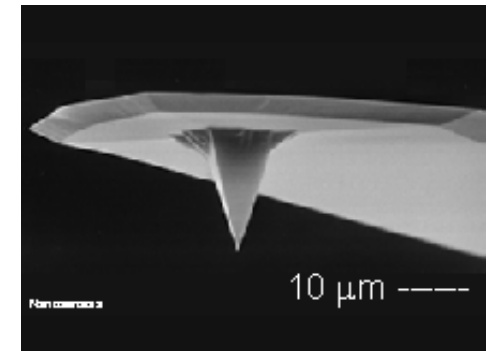
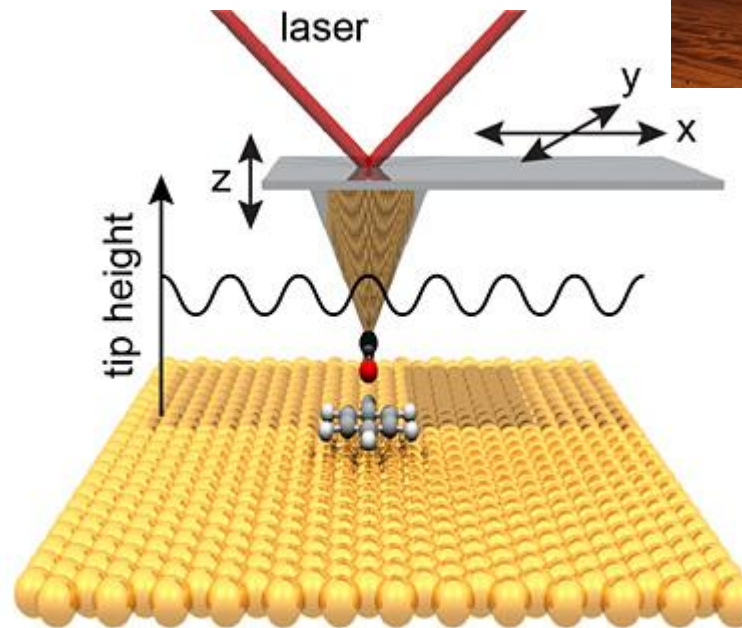
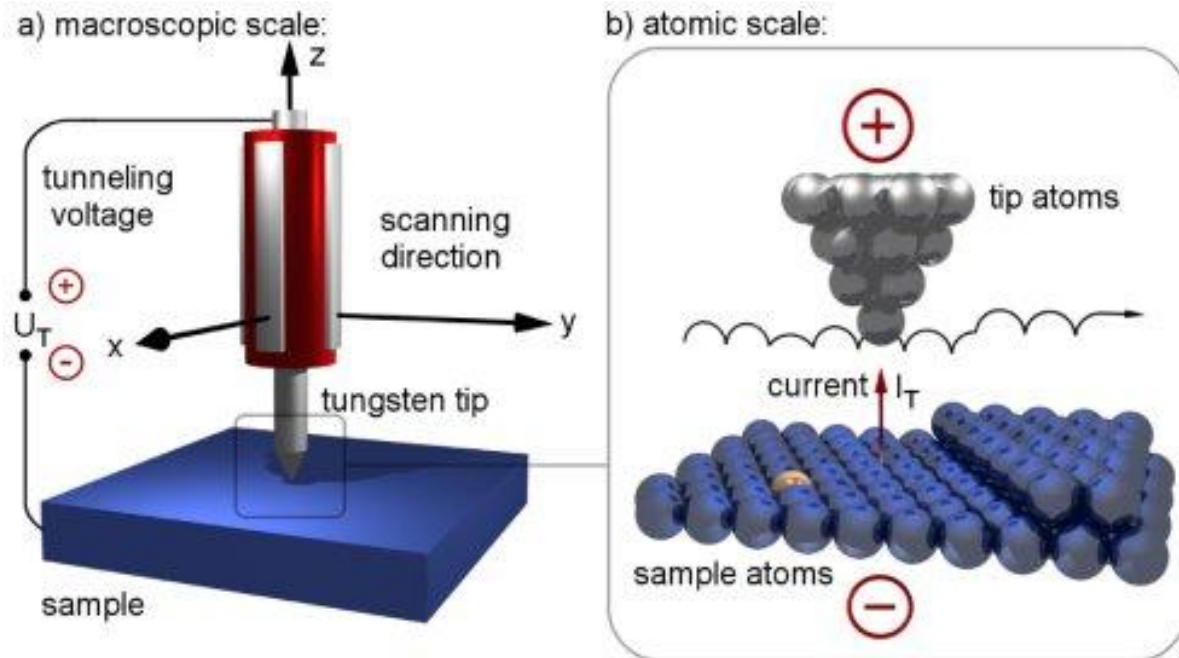
FEI Titan



Tescan Lyra GM

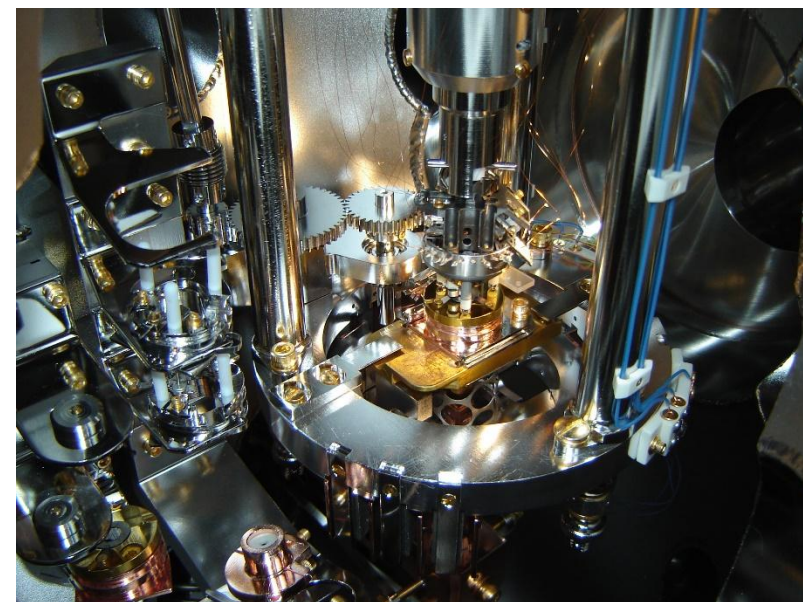
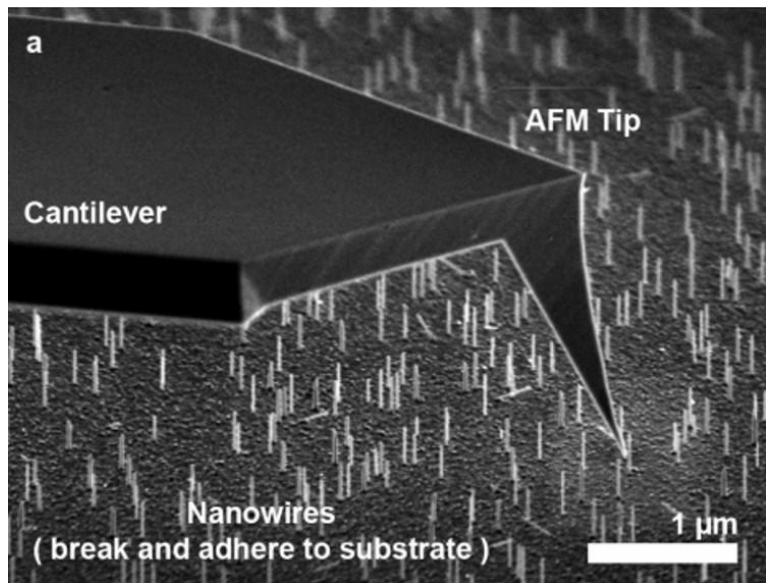
Mikroskopy a Nanoskopy

- Rastrovací tunelovací mikroskop (STM)
- Mikroskop atomárních sil (AFM)



G. Binnig, H. Rohrer (1986). "Scanning tunneling microscopy". *IBM Journal of Research and Development* **30**: 4.

Mikroskopy a Nanoskopy

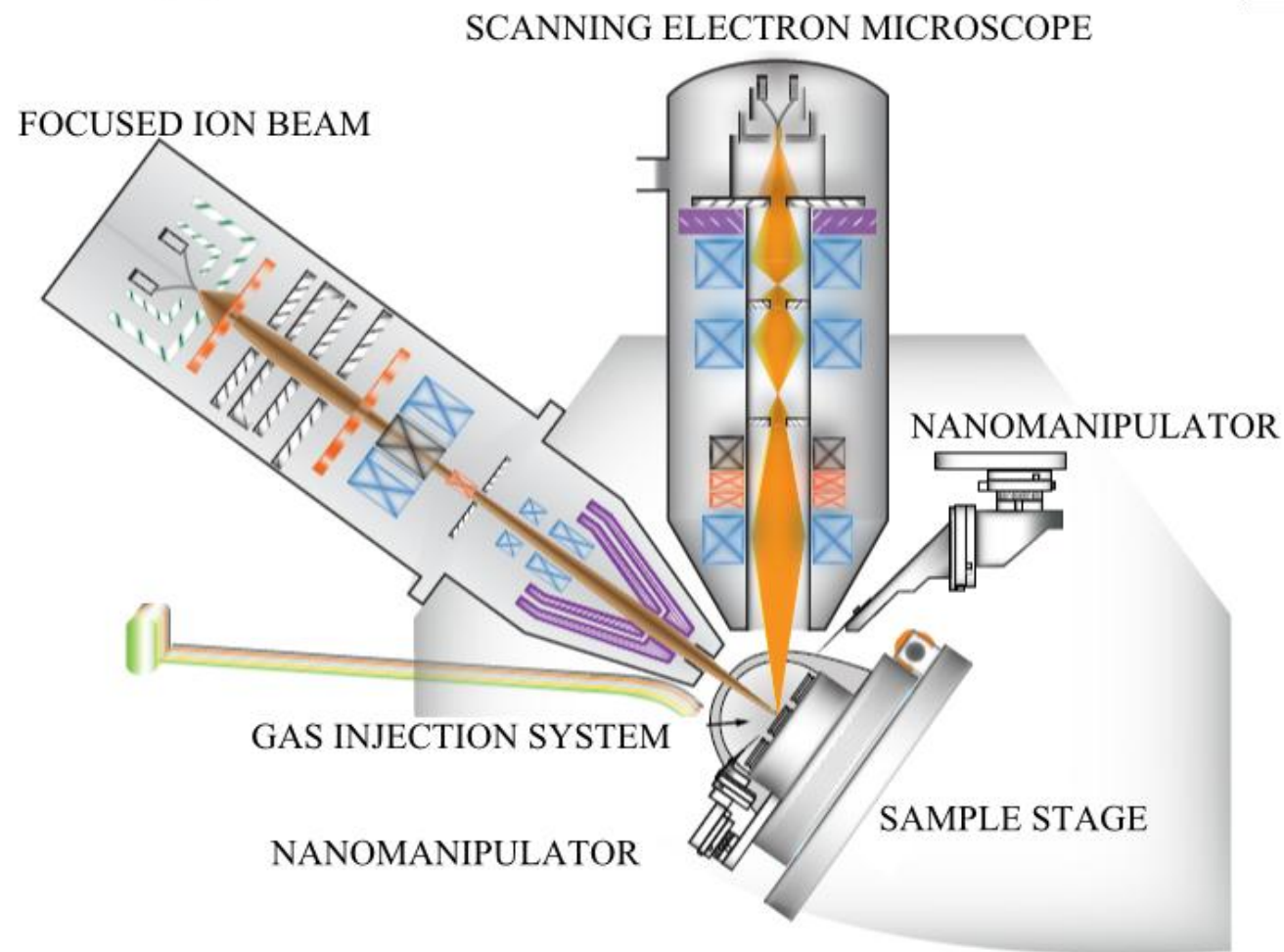
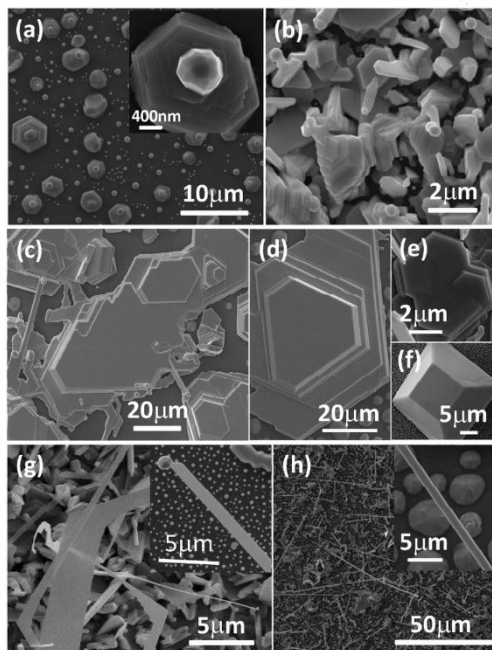
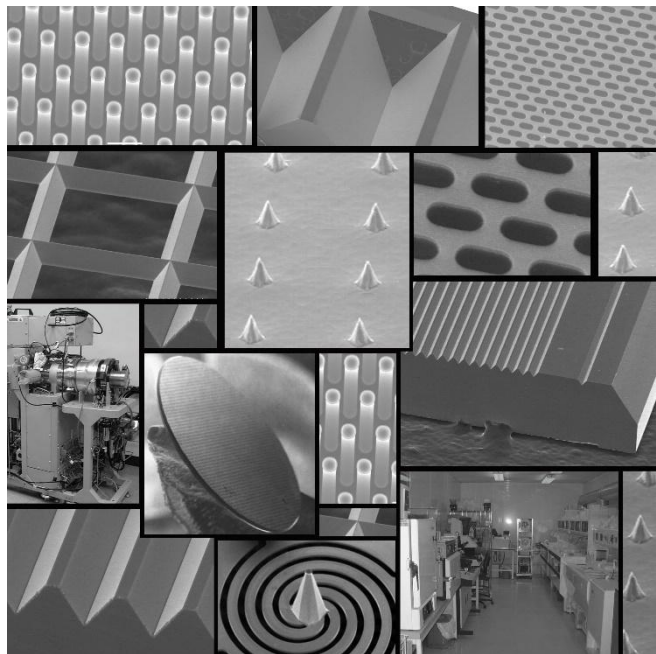


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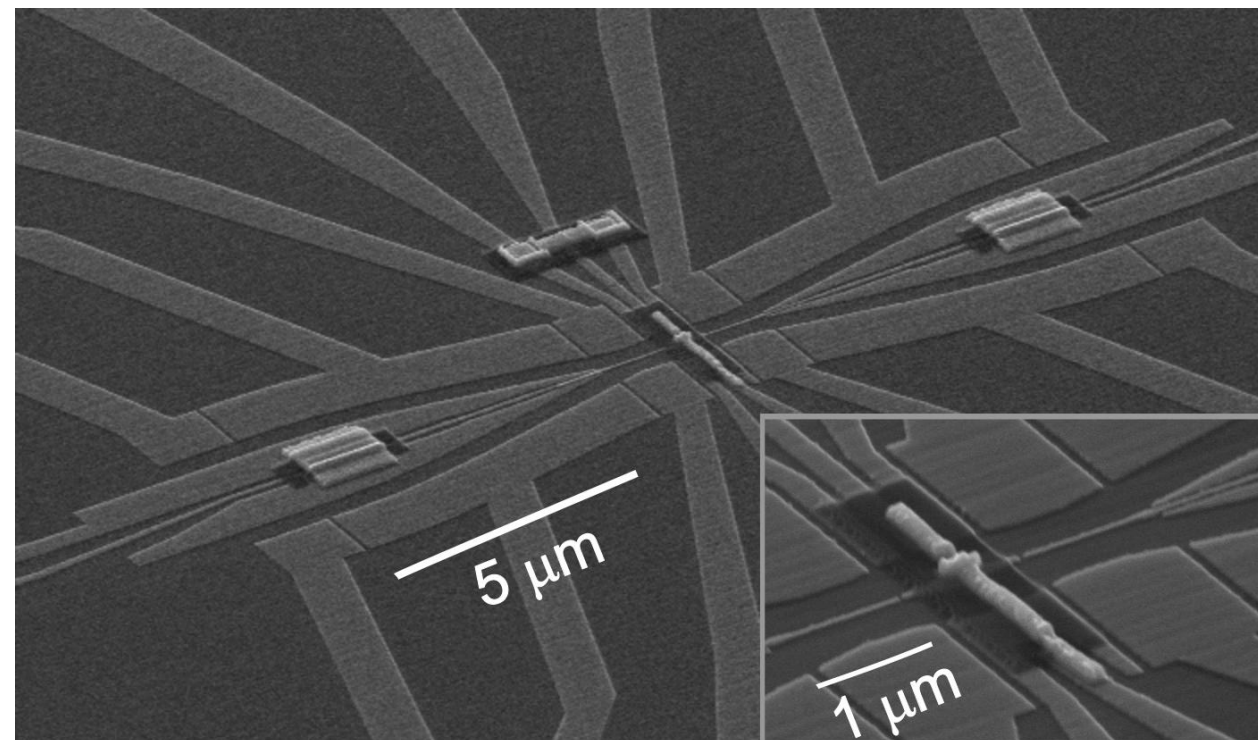
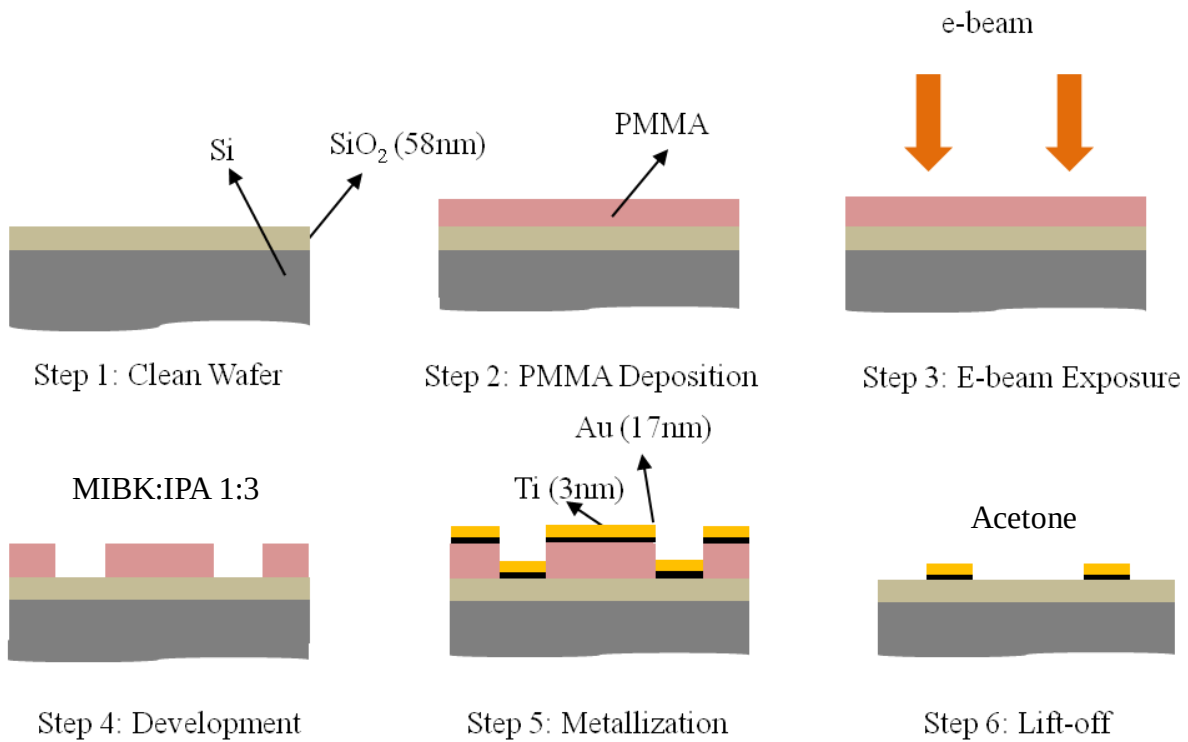
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Výroba nanostruktur

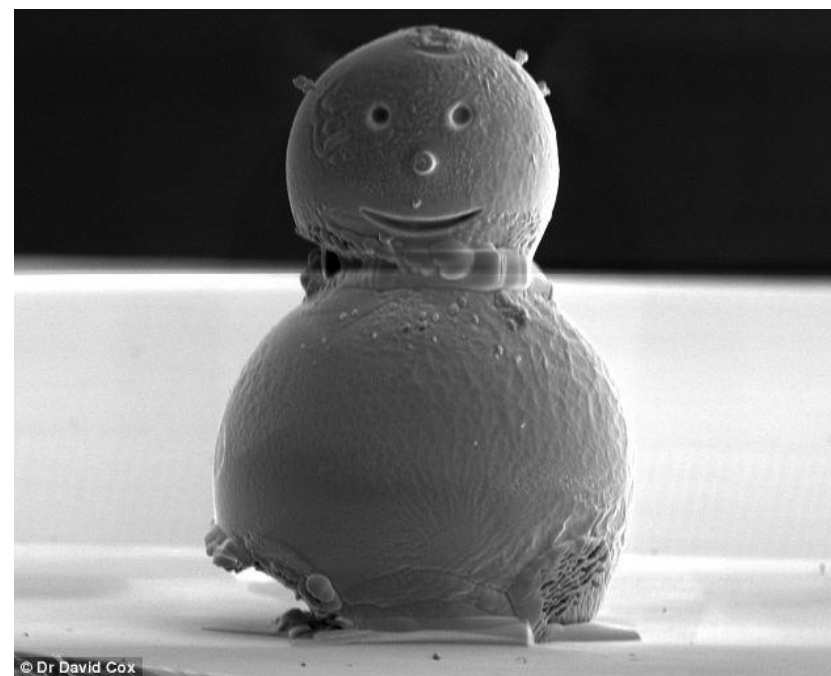
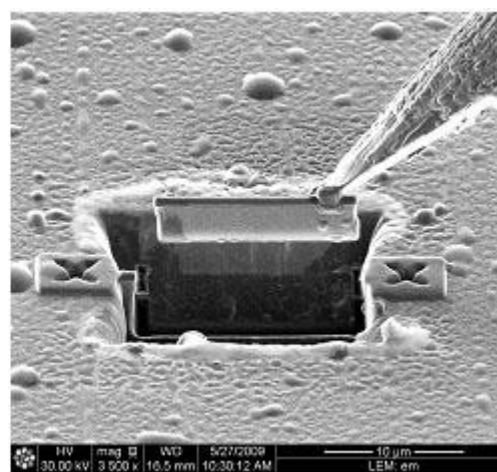
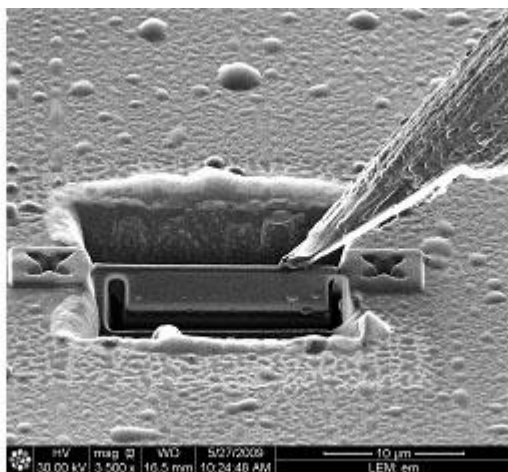
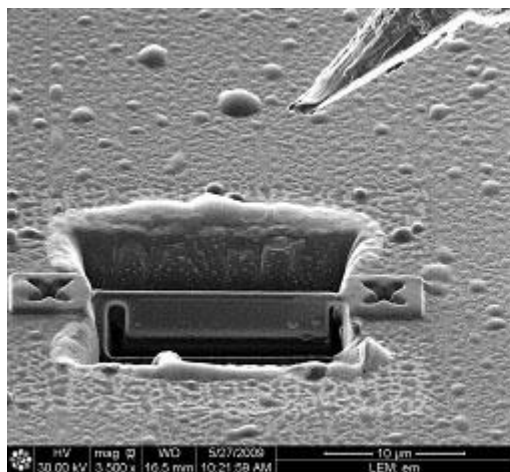
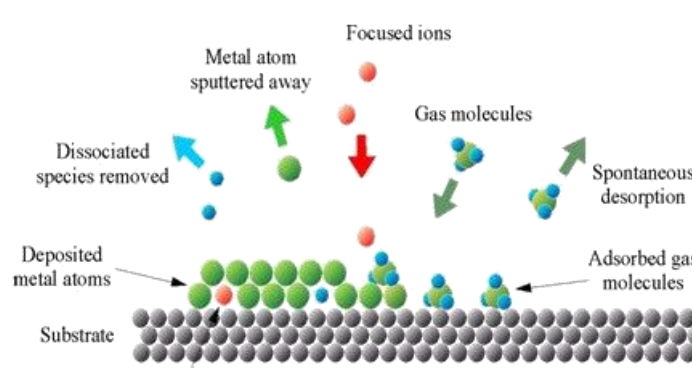
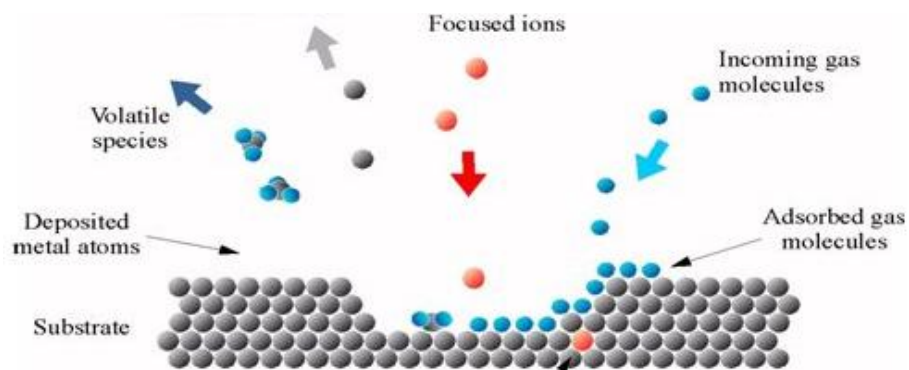
- Elektronová litografie
- Samouspořádávání
- Iontové leptání



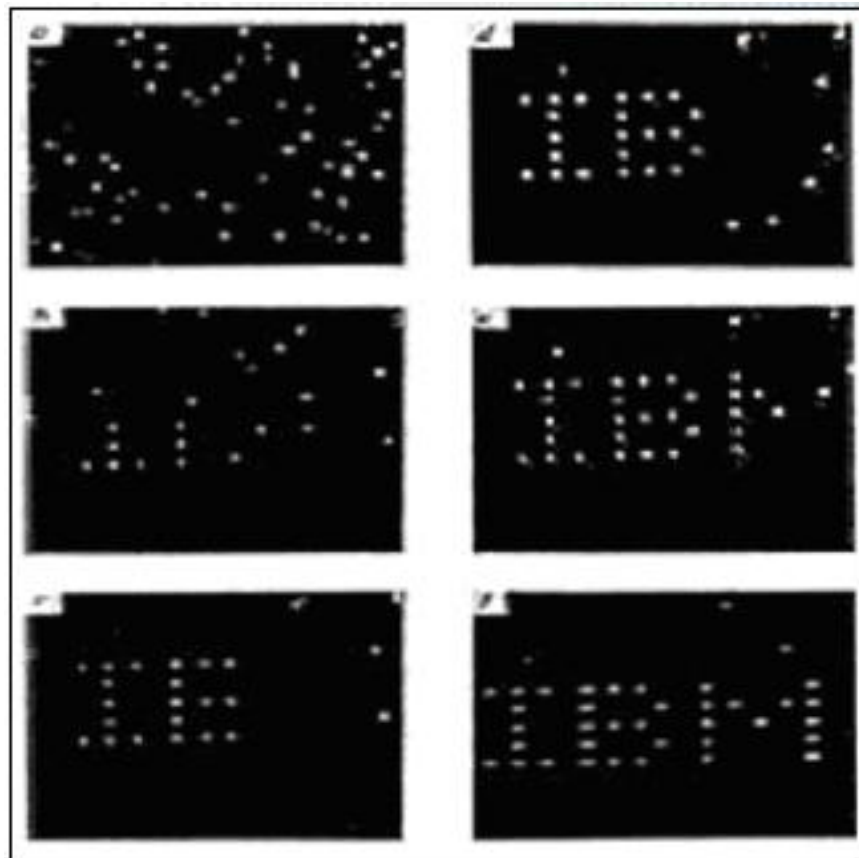
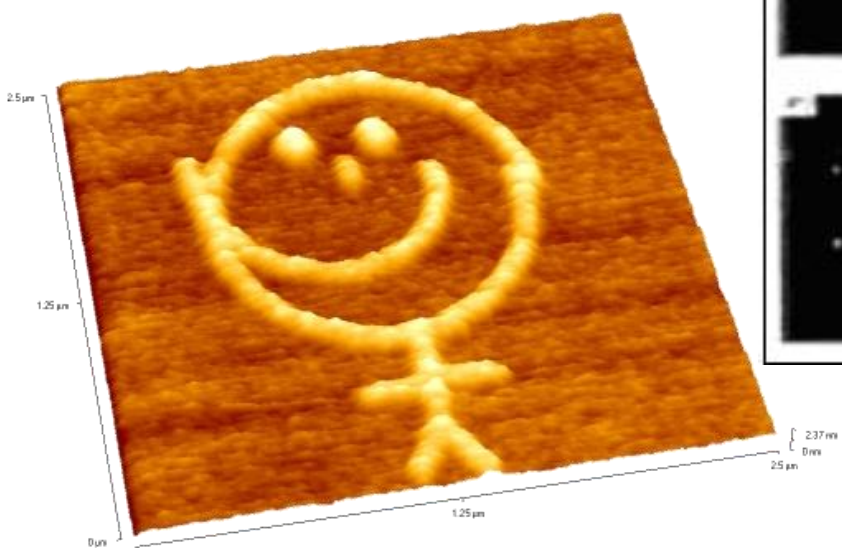
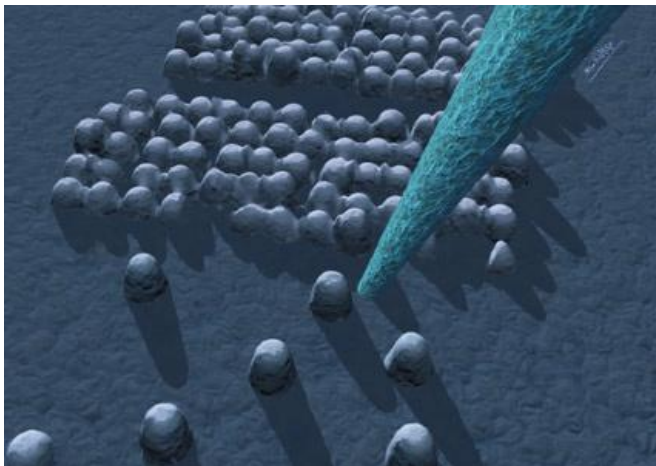
Elektronová litografie



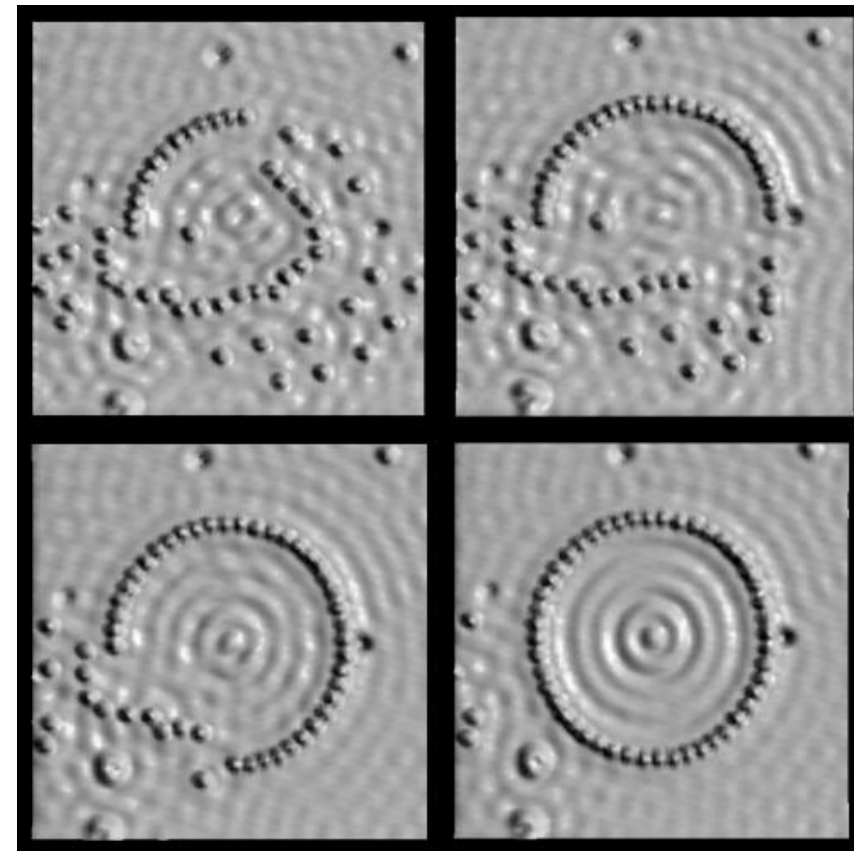
Fokusovaný iontový svazek



Hrotové metody

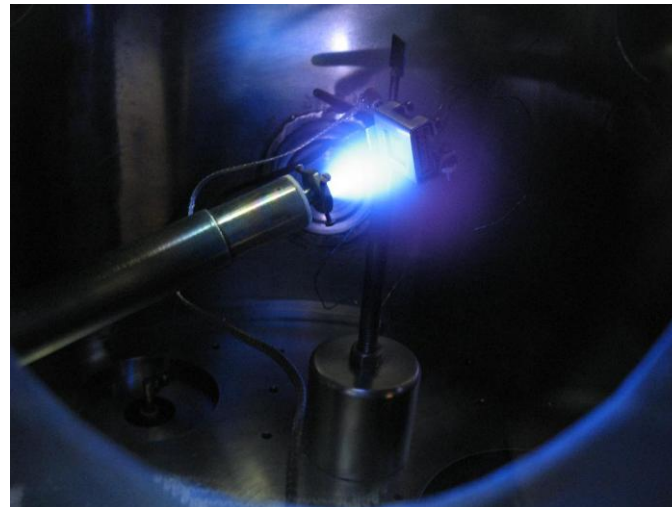
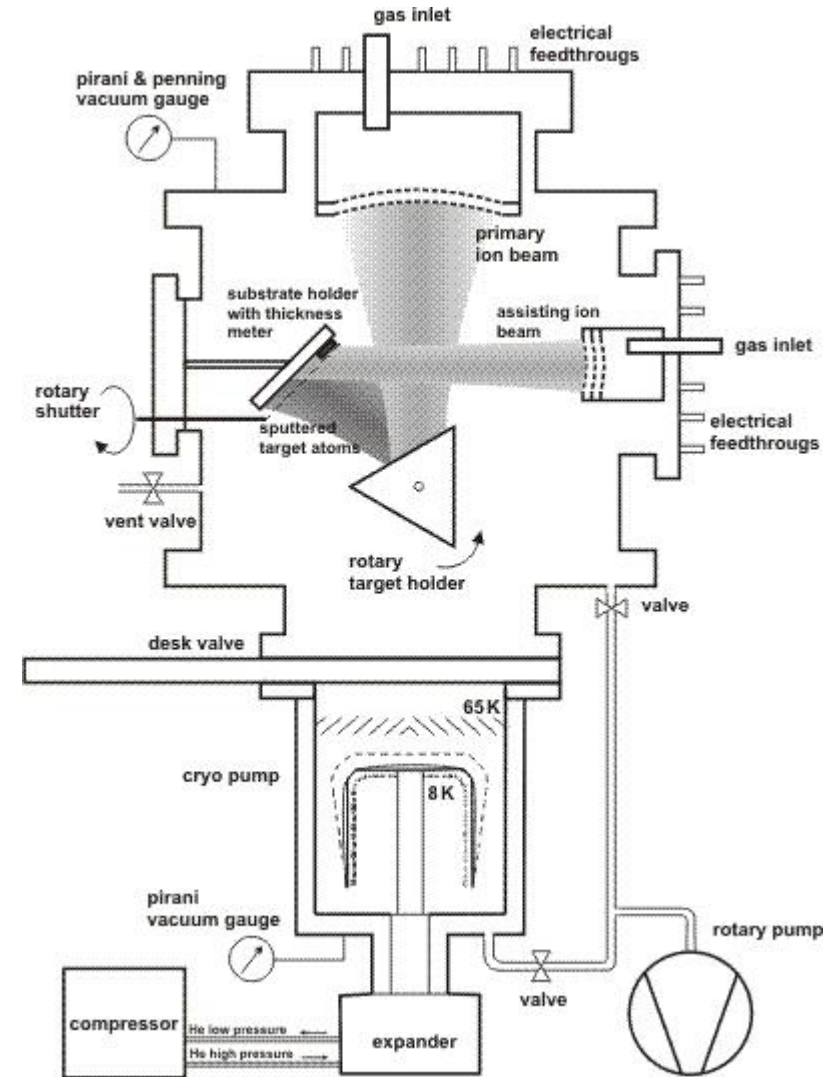
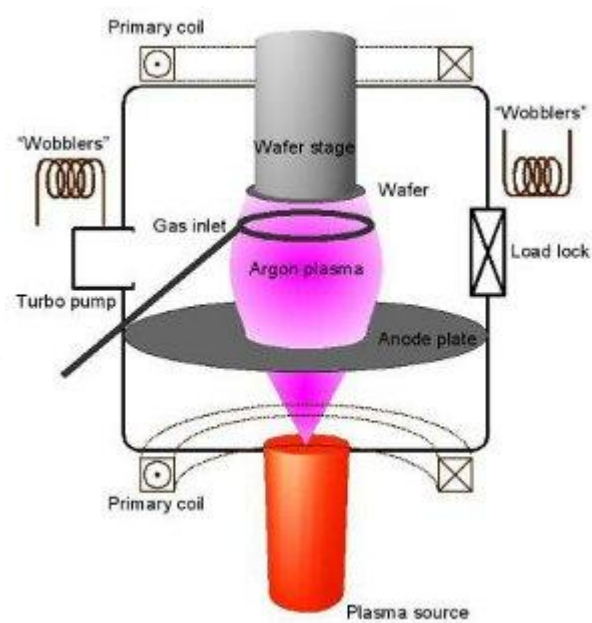
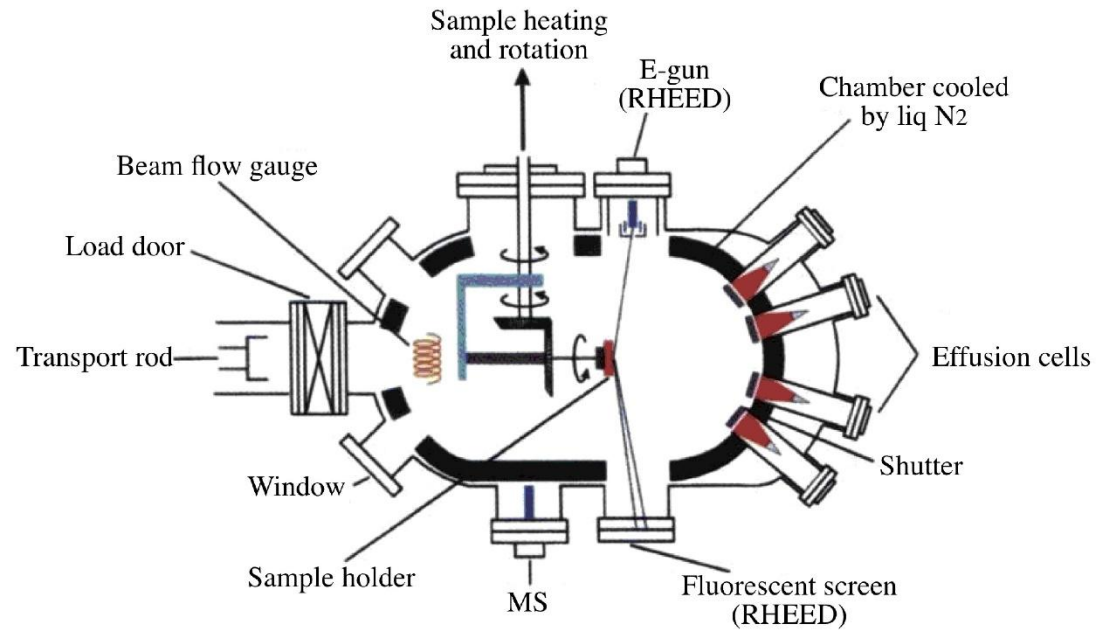


Xe atomy na Si substrátu

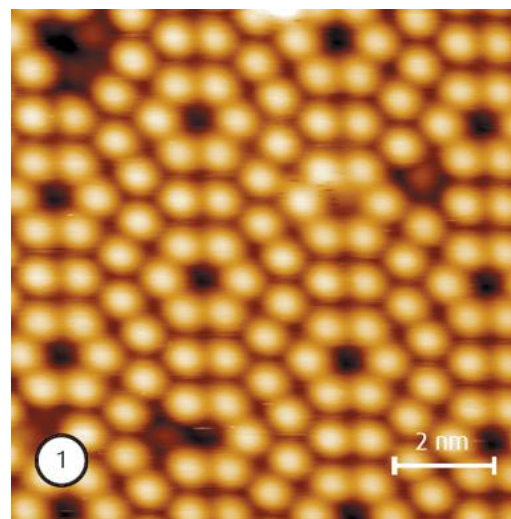
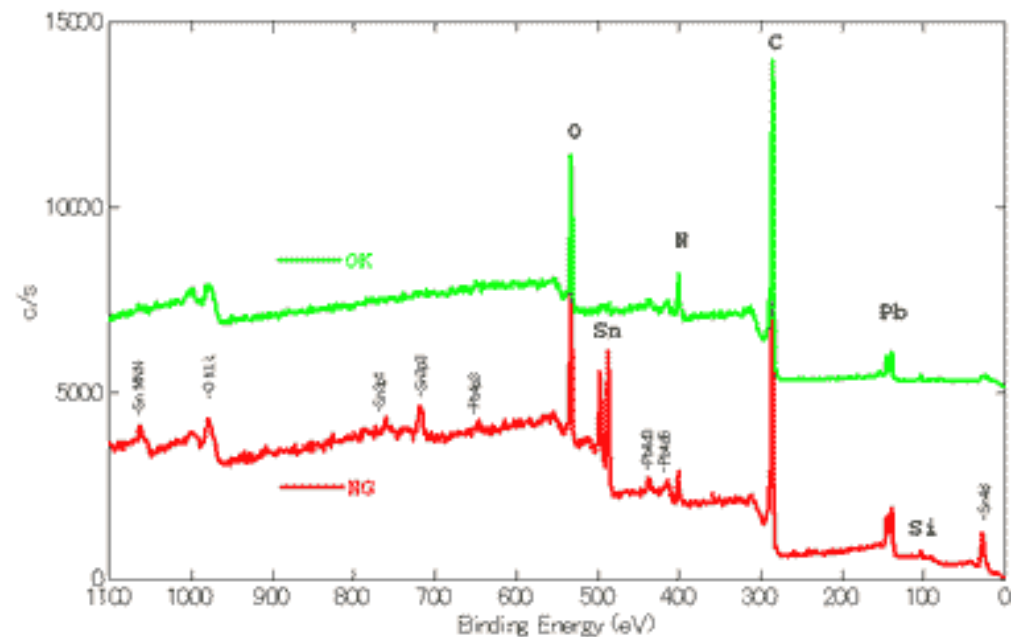
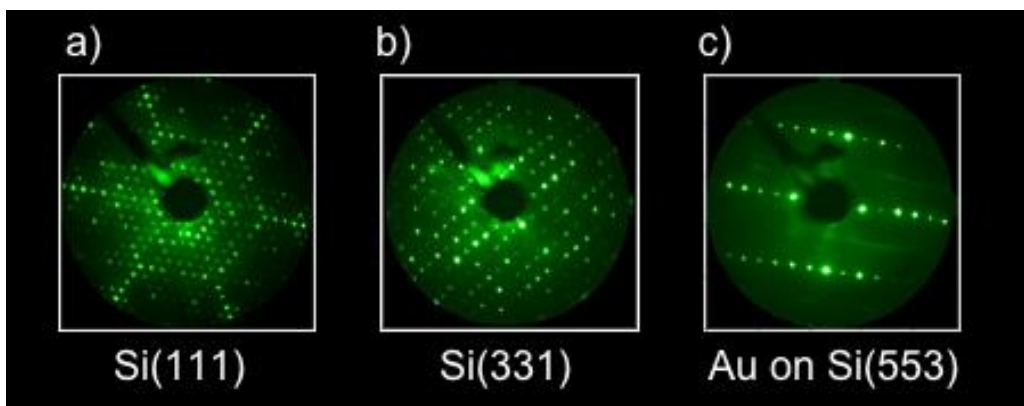


Fe atomy na Cu substrátu

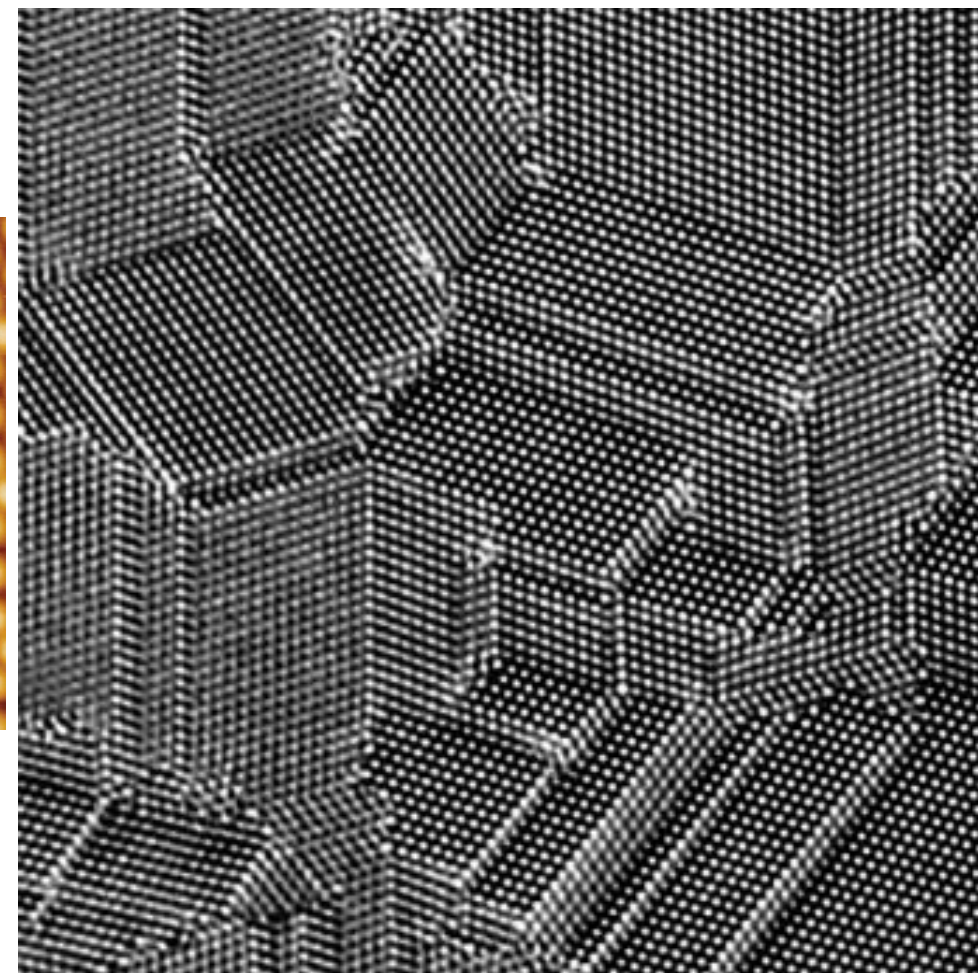
Depozice tenkých vrstev



Mechanické a chemické vlastnosti

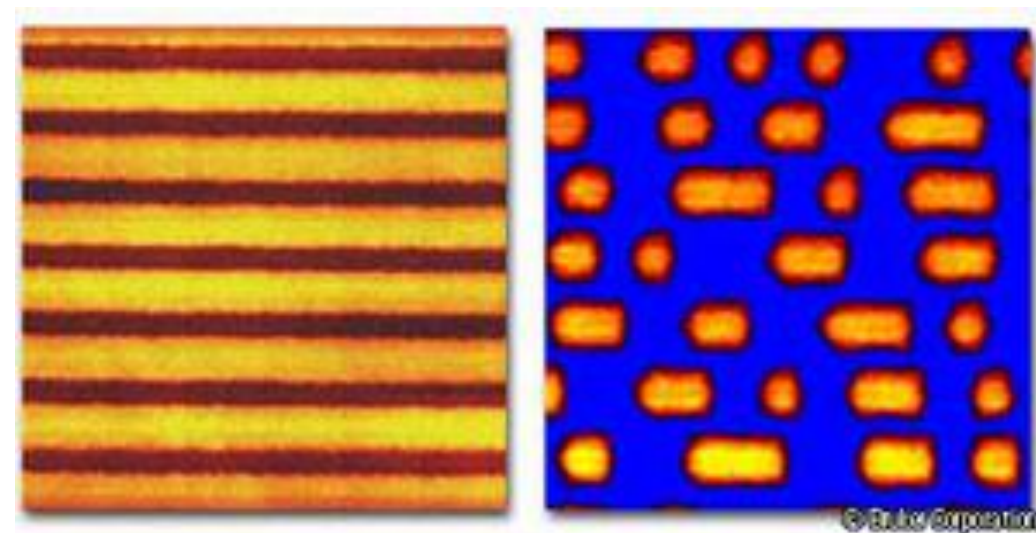
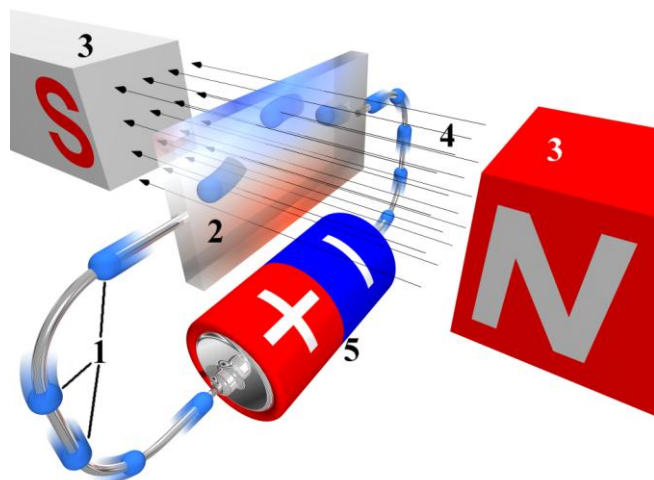
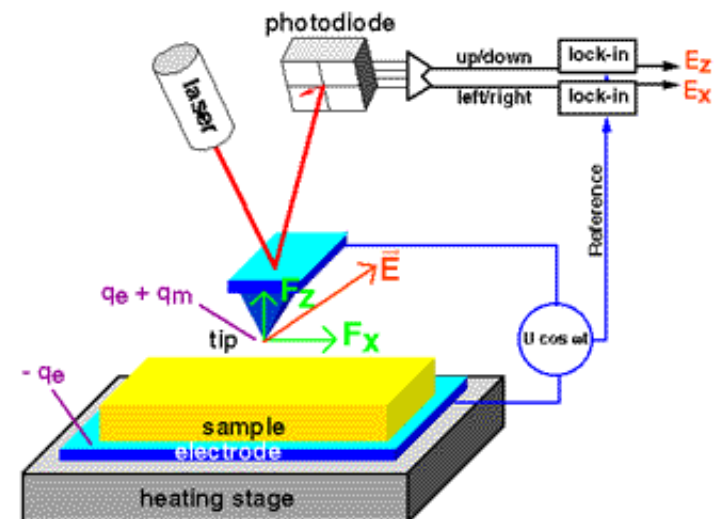
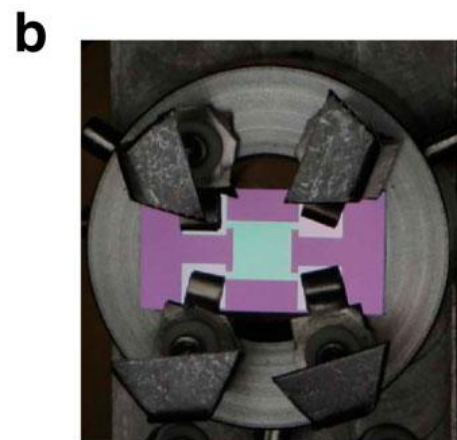
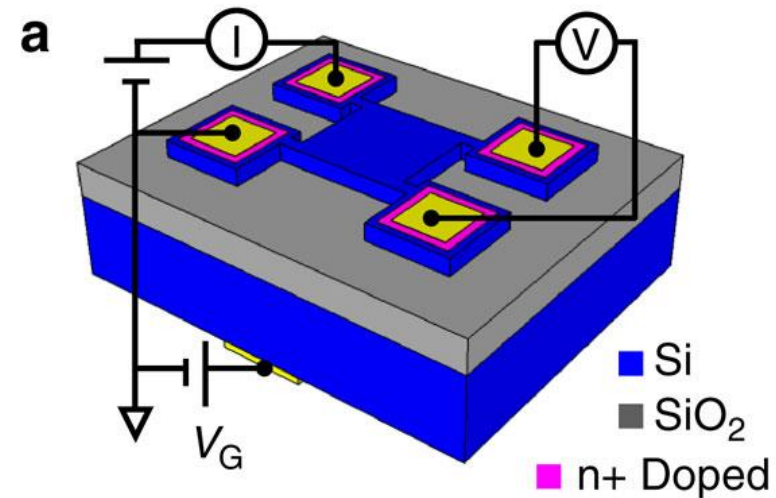


Krystalický Si



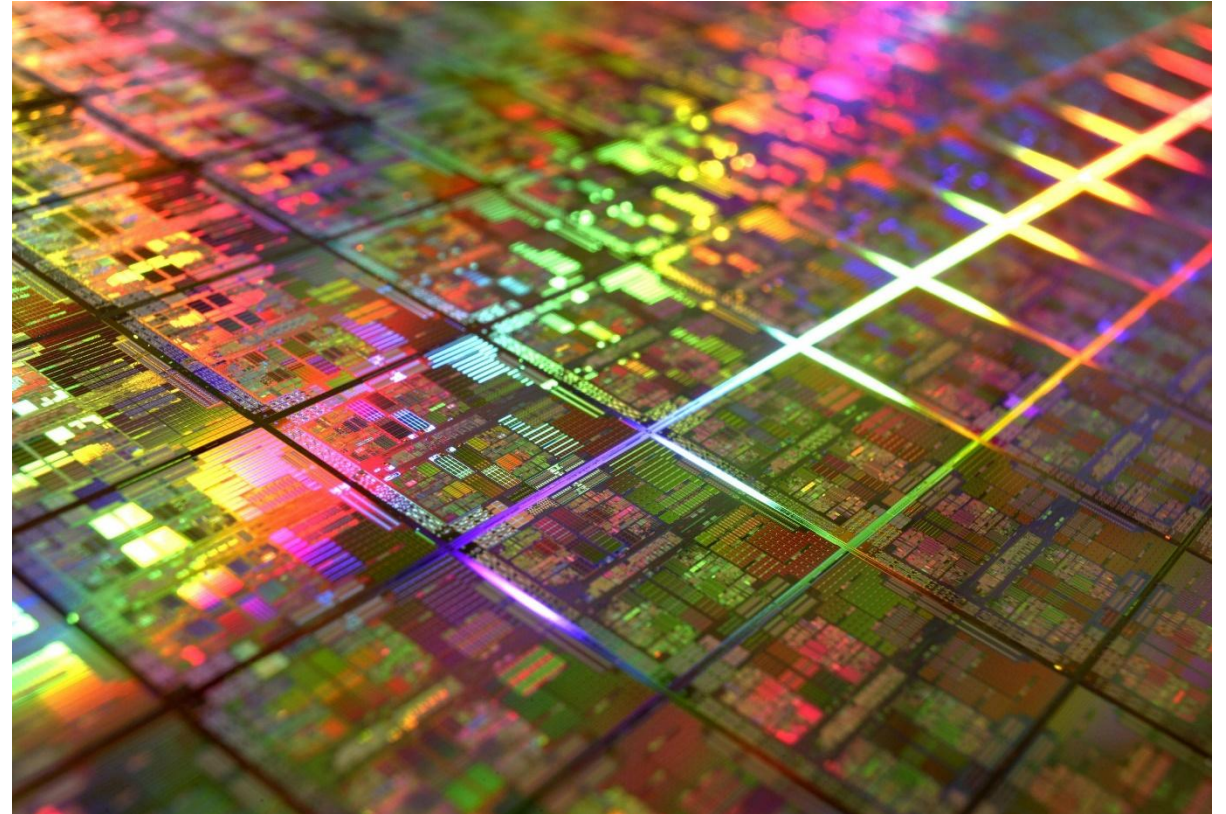
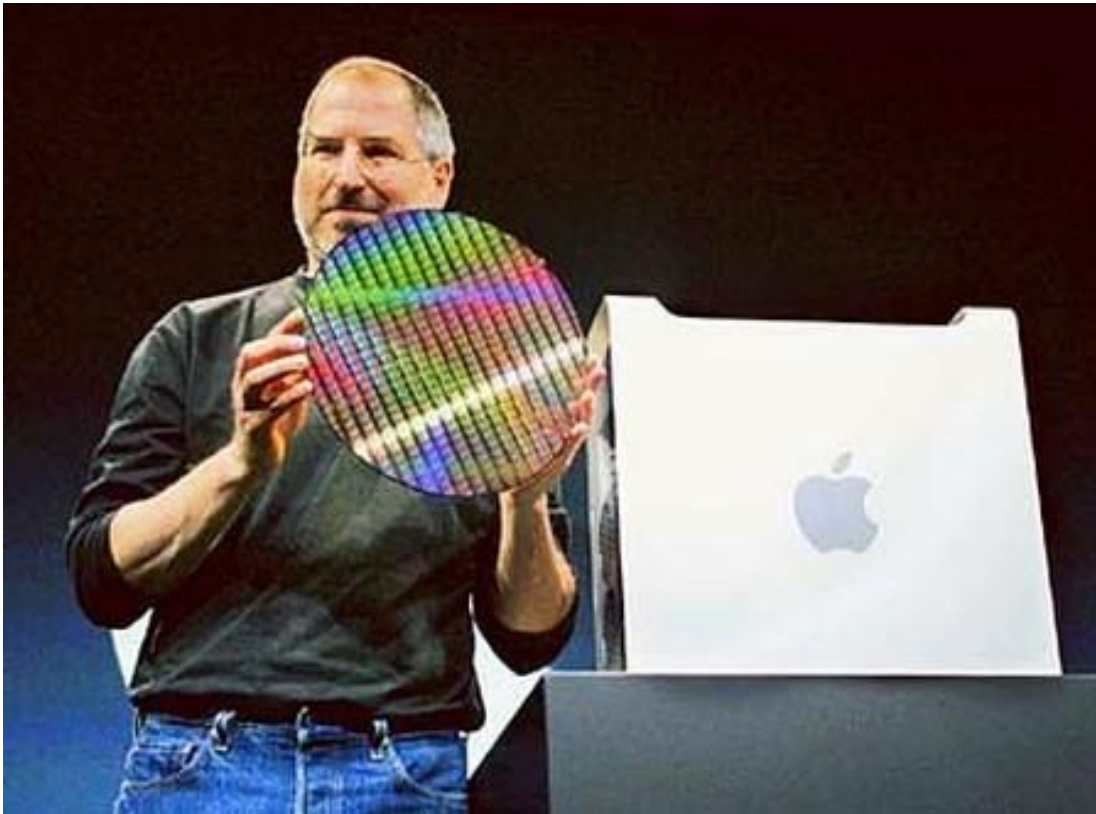
Polykrystalický Si [T. Vystavěl, CEA Grenoble, Francie]

Elektrické vlastnosti

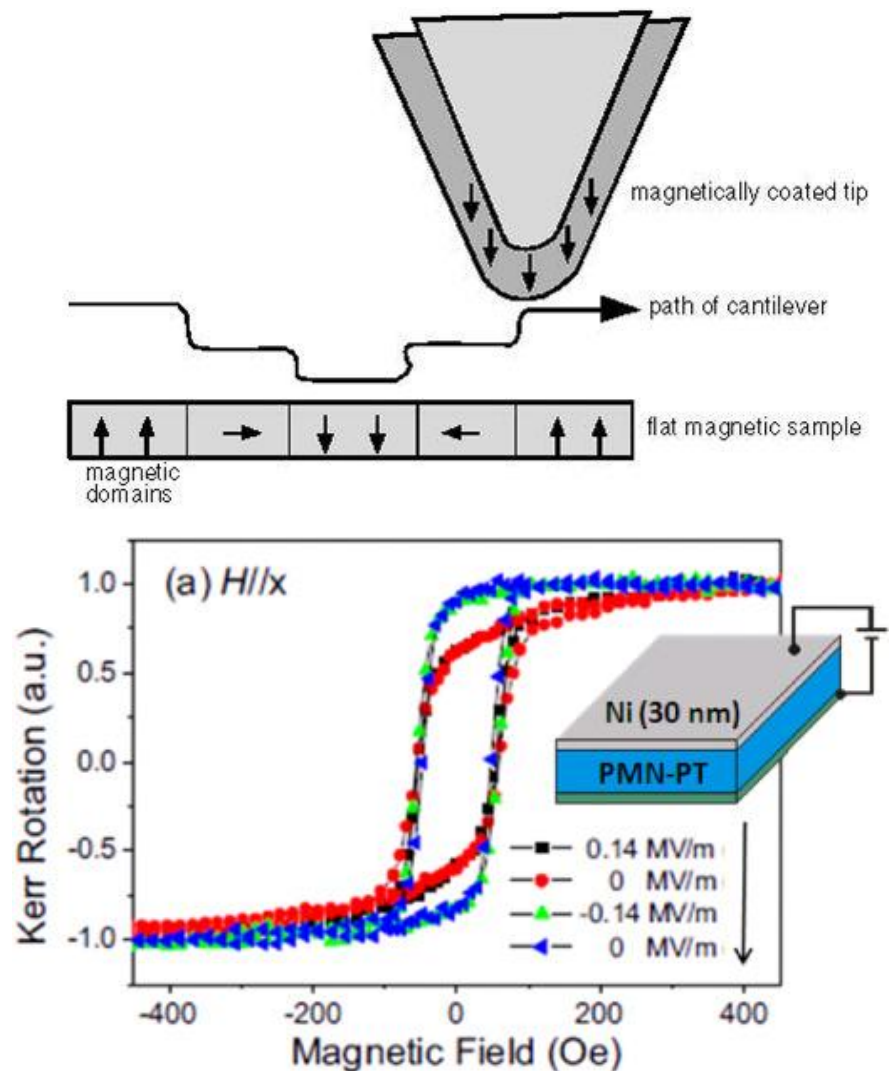


DVD-RW [Yasuko Ichikawa, Toyo Corporation, Japan] (5 x 5) μm^2

Mikroelektronika



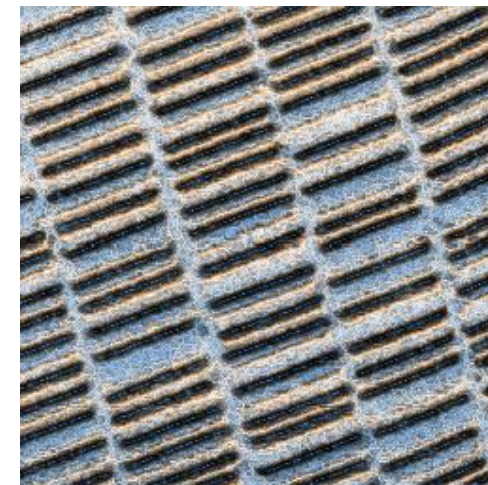
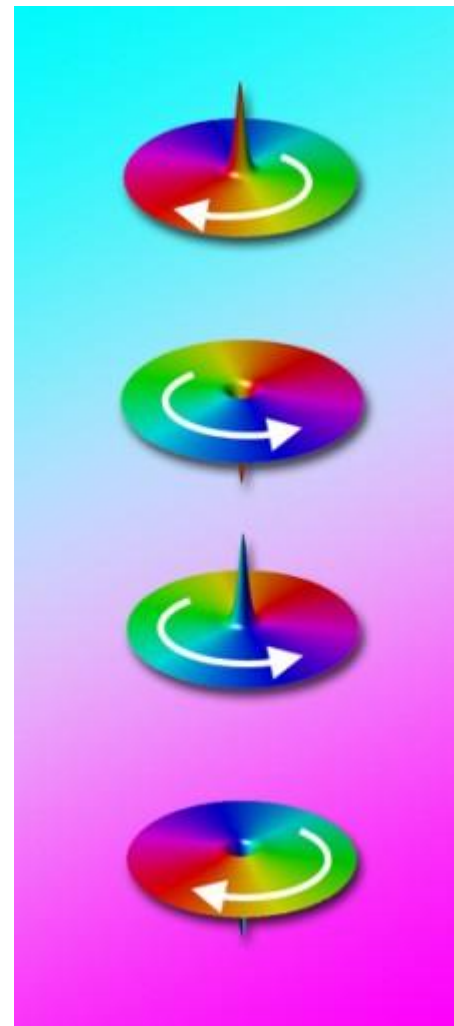
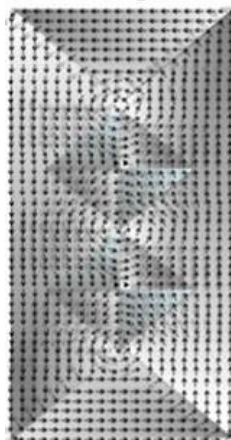
Magnetické vlastnosti



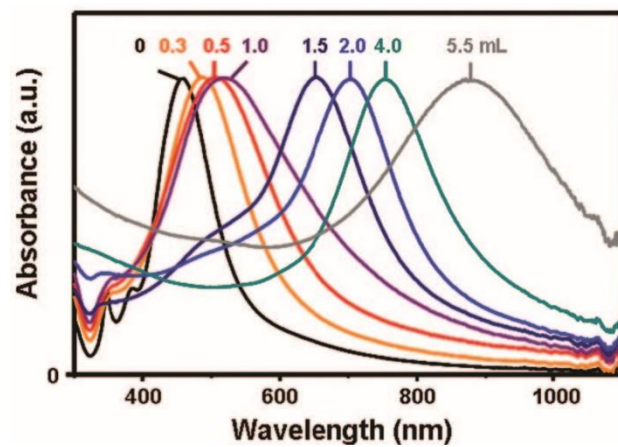
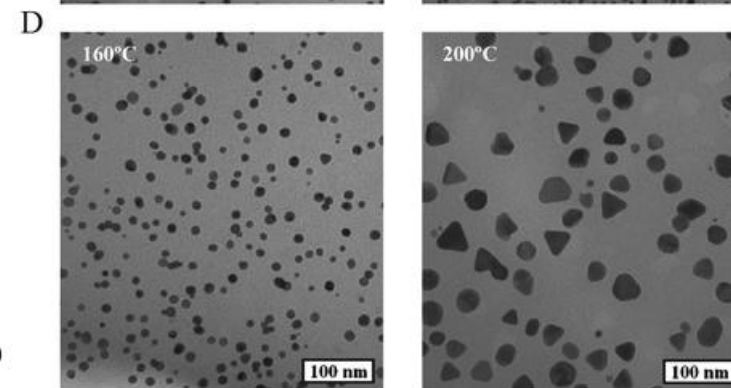
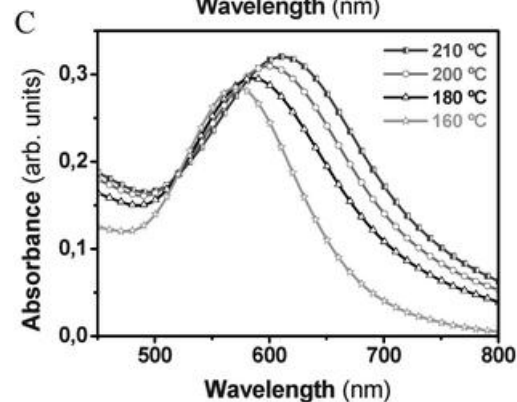
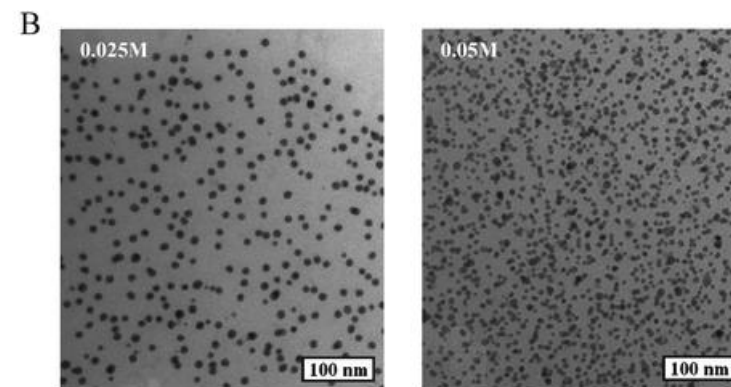
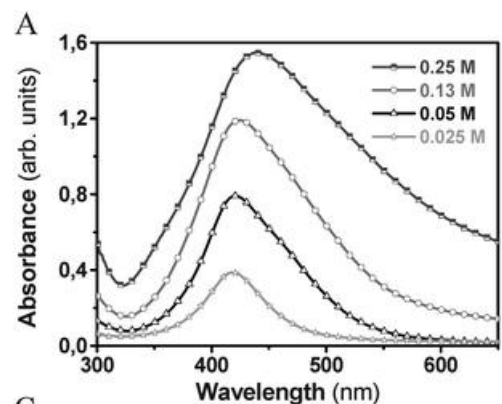
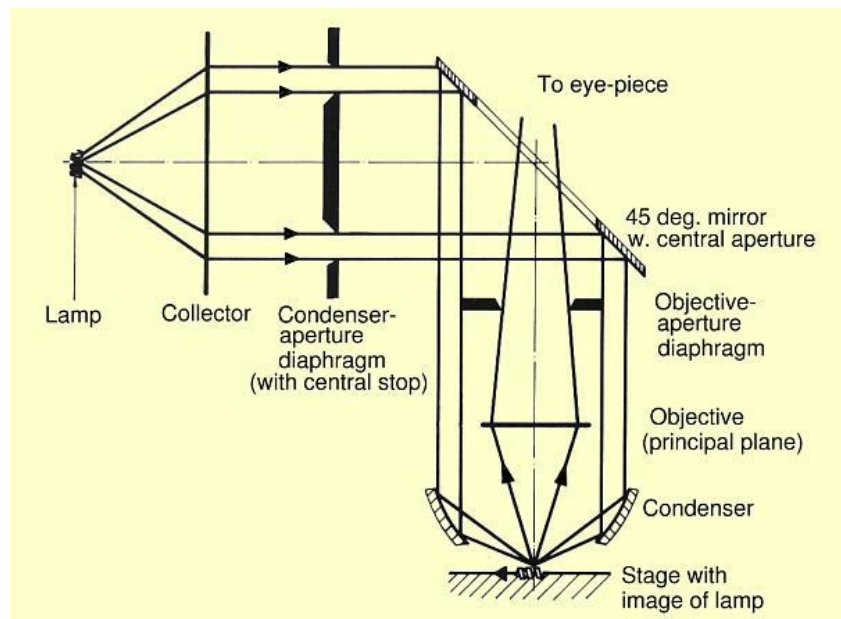
MFM Image



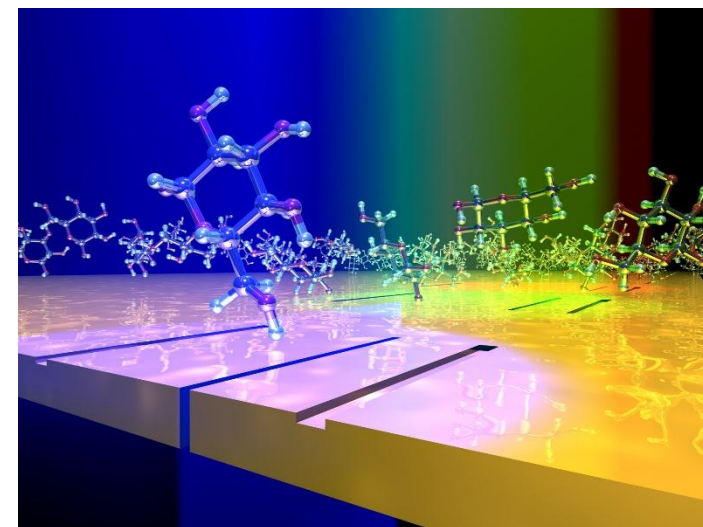
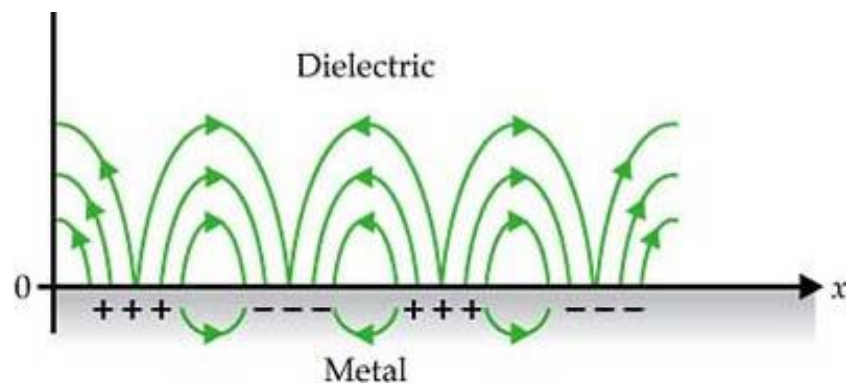
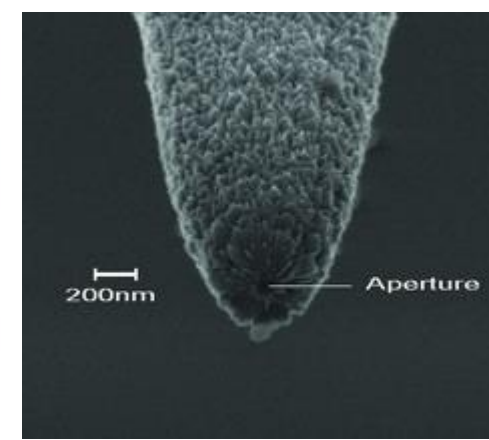
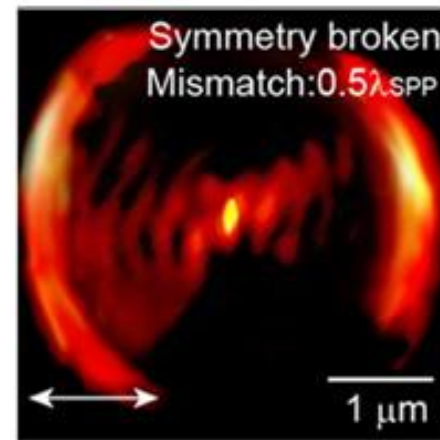
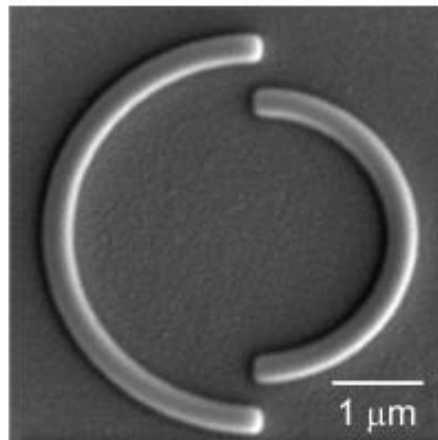
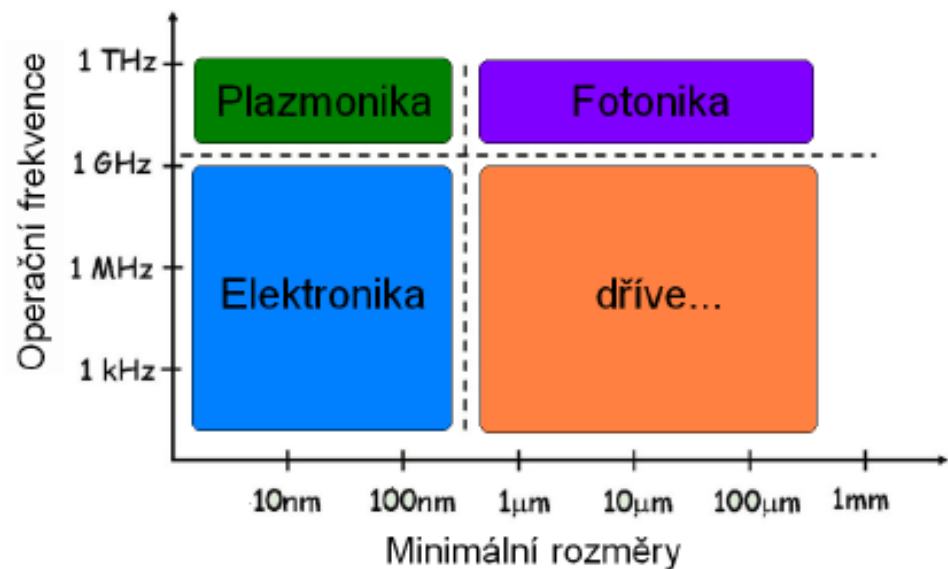
Micromagnetics



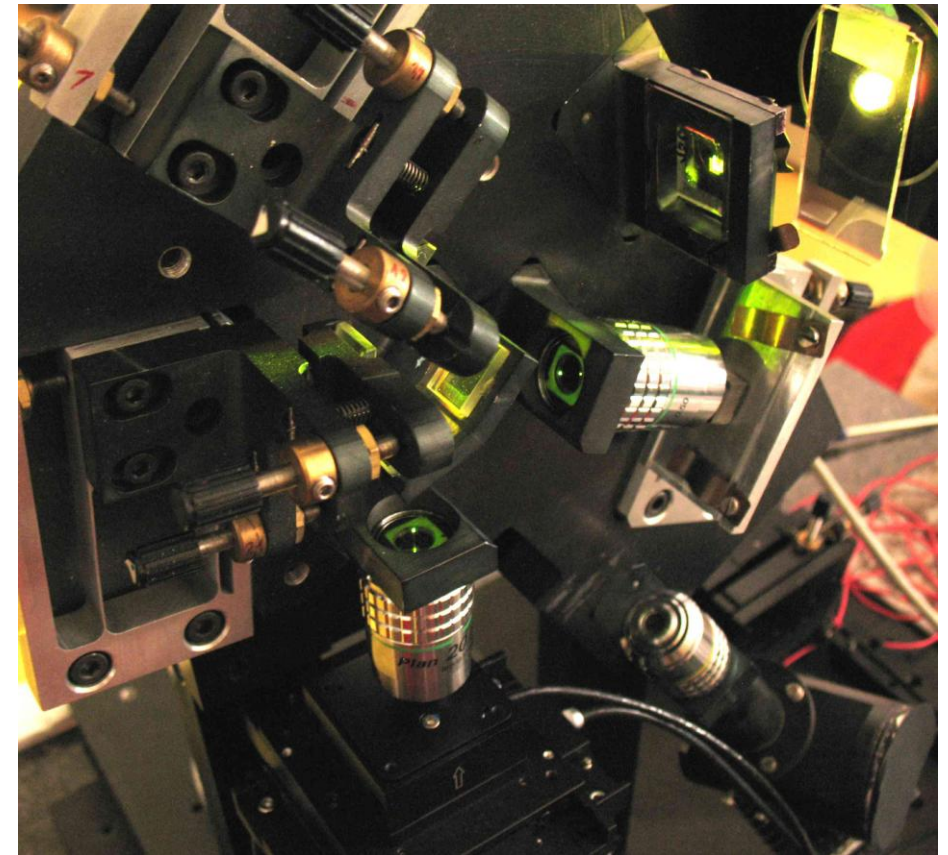
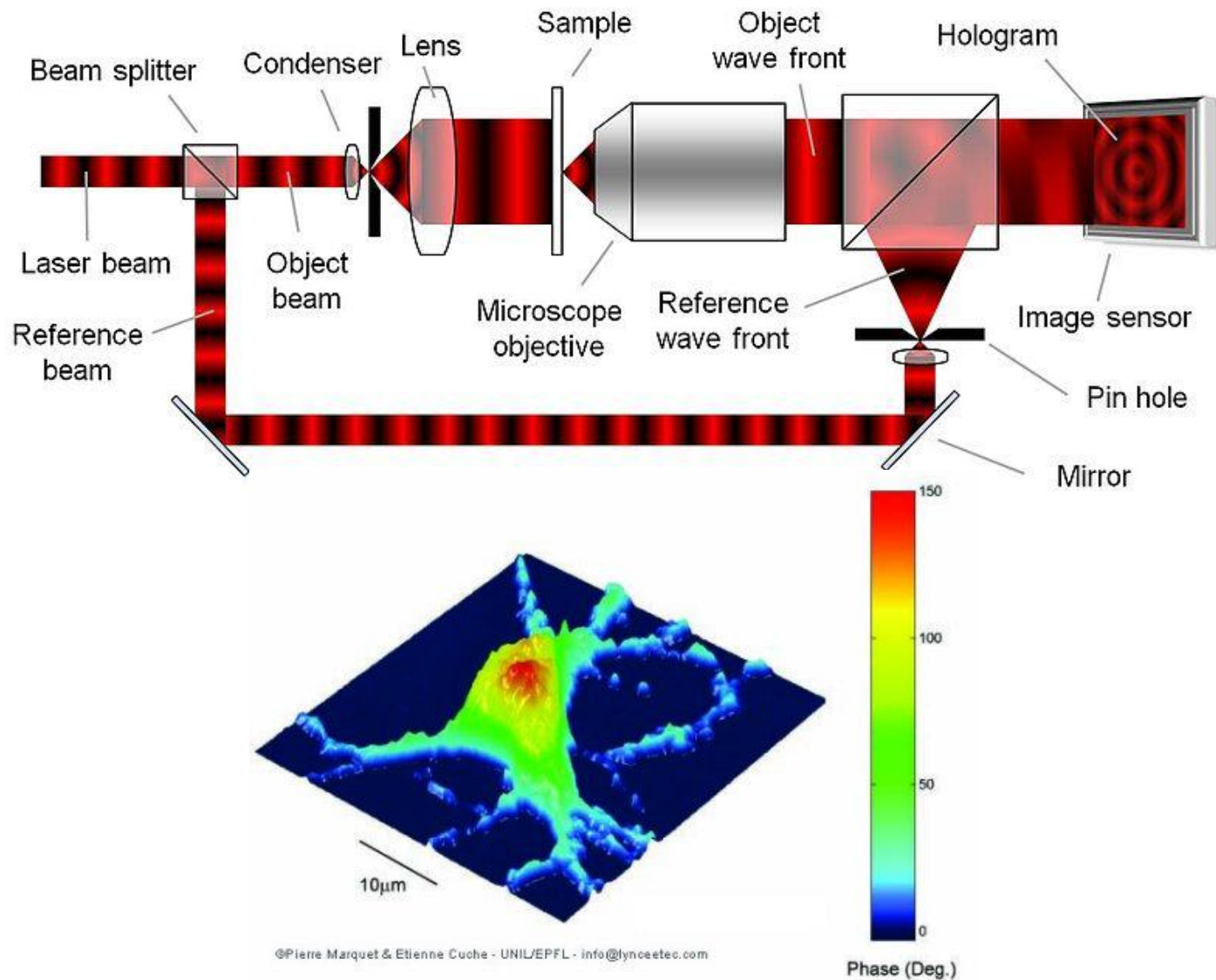
Optické vlastnosti



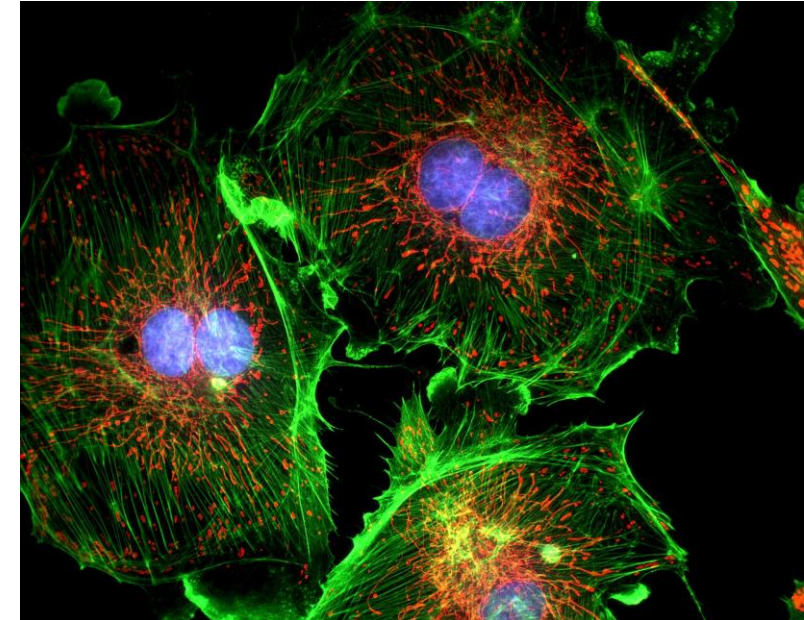
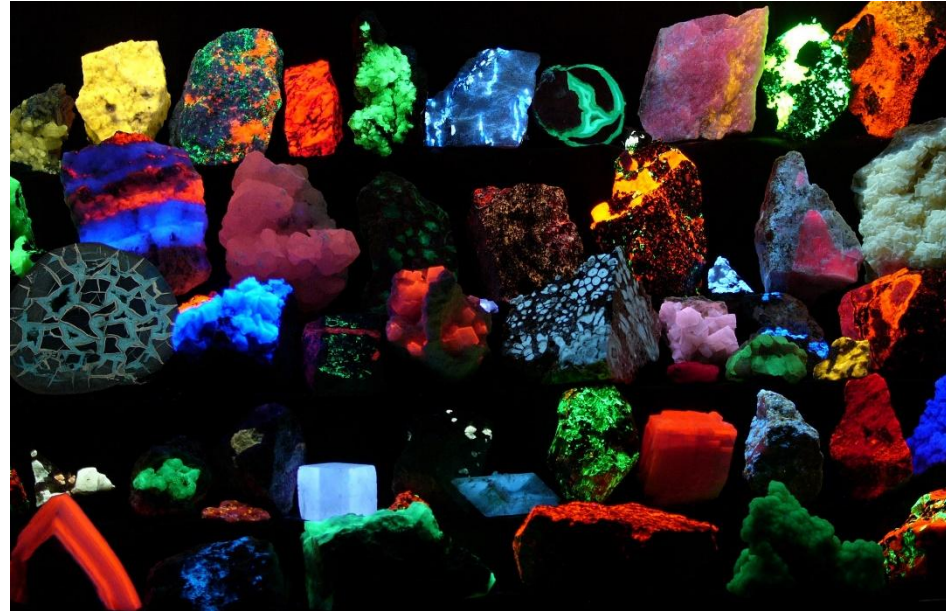
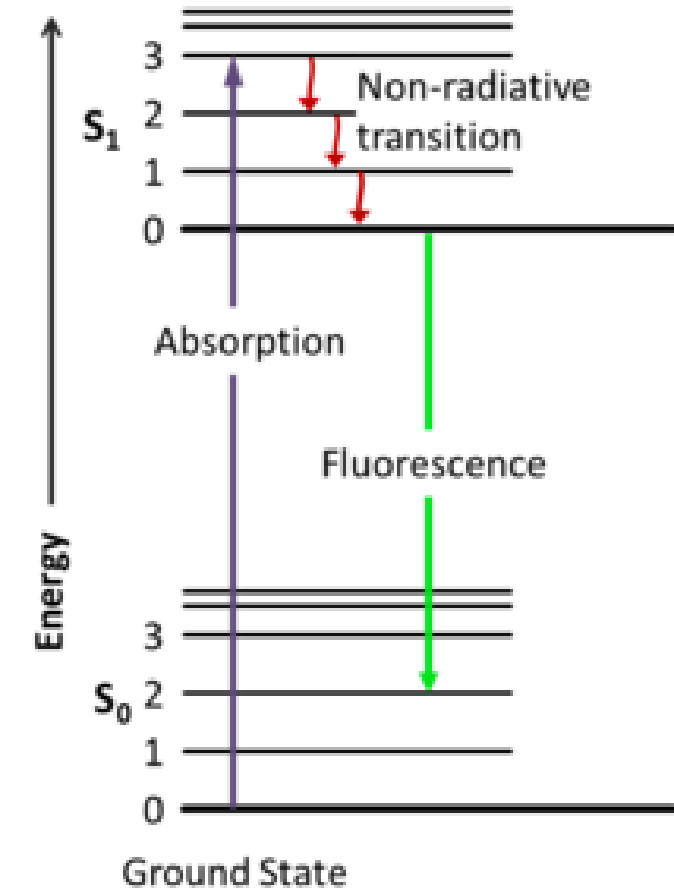
Plazmonika



Holografická mikroskopie



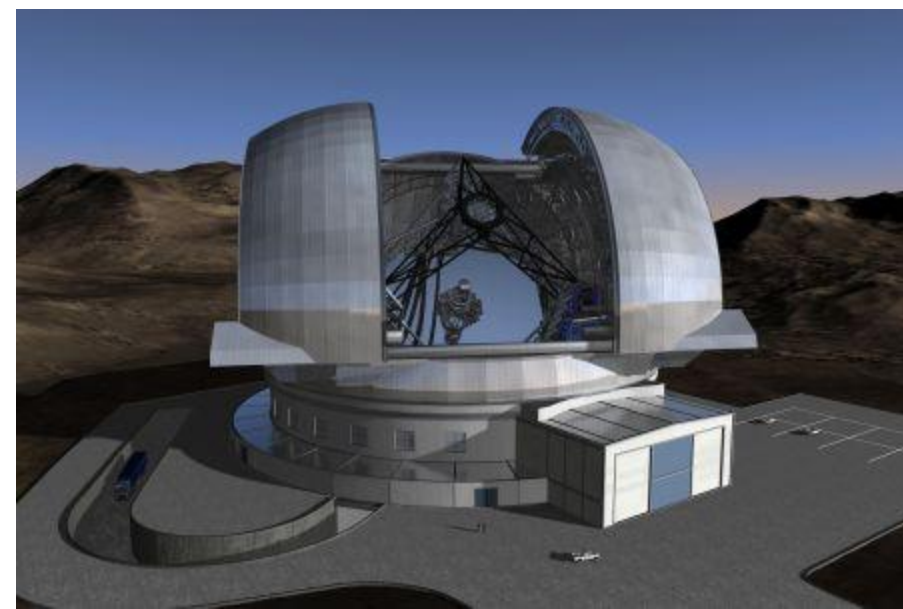
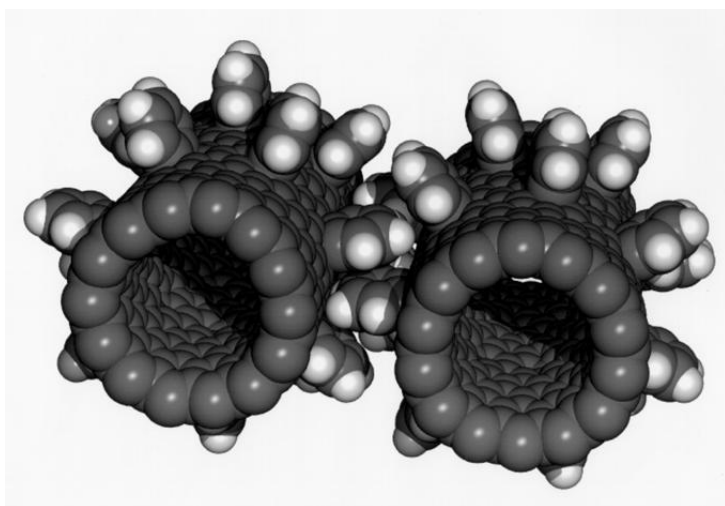
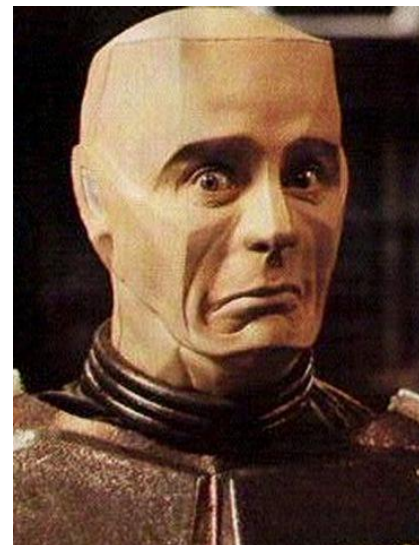
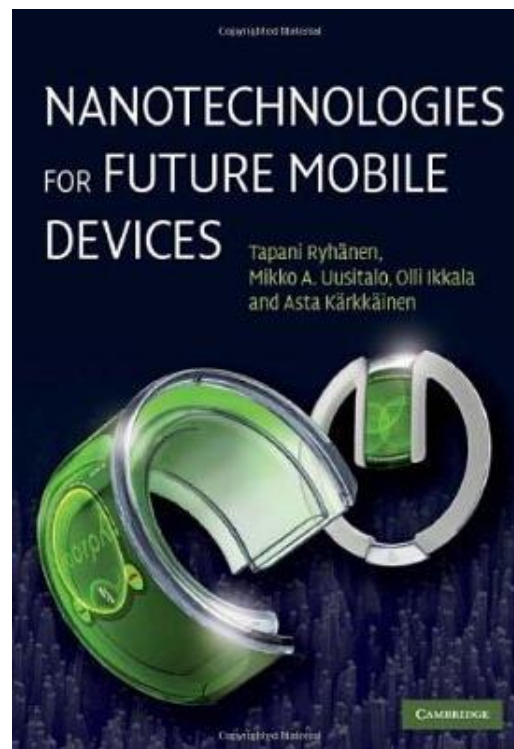
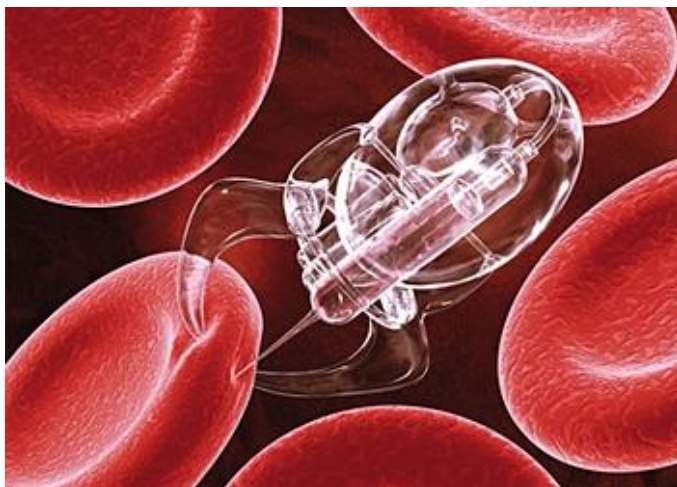
Fluorescence



Obsah

- Úvod a historie nanotechnologií
- Nanotechnologie v praxi a jejich aplikace
- Nanomateriály
- Nanoskopy a mikroskopy
- Výroba nanostruktur a jejich vlastnosti
- **Budoucnost nanotechnologií**

Budoucnost nanotechnologií



Děkuji za pozornost

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