UNIVERSIDADE FEDERAL
DO ESPÍRITO SANTO

Universo no Parque

UFES

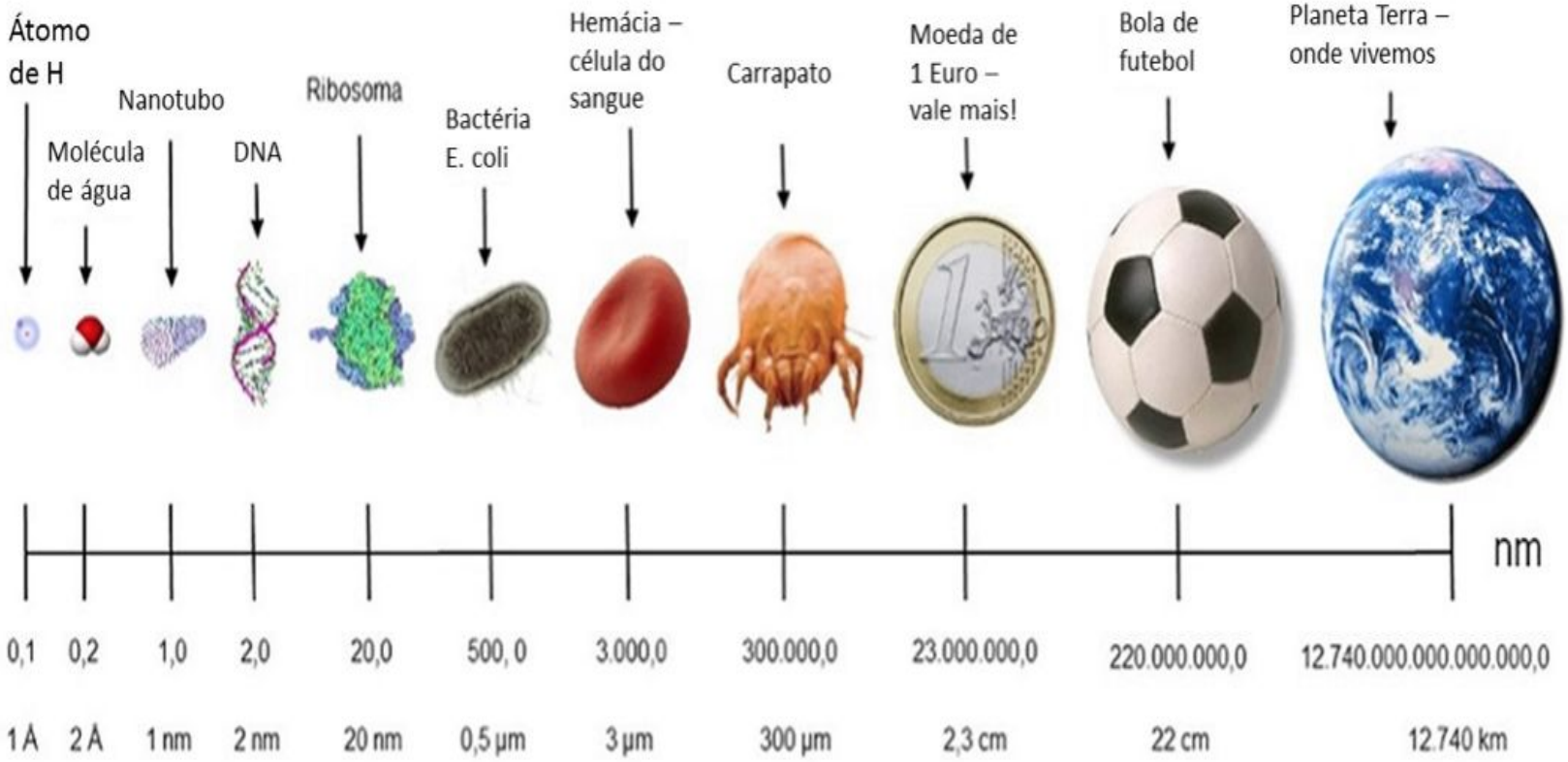
Nanoscoisas: Física em nanoescala

Departamento de Física da UFES
Programa de pós-graduação em Física (PPGFIS)

Wanderlã Luis Scopel

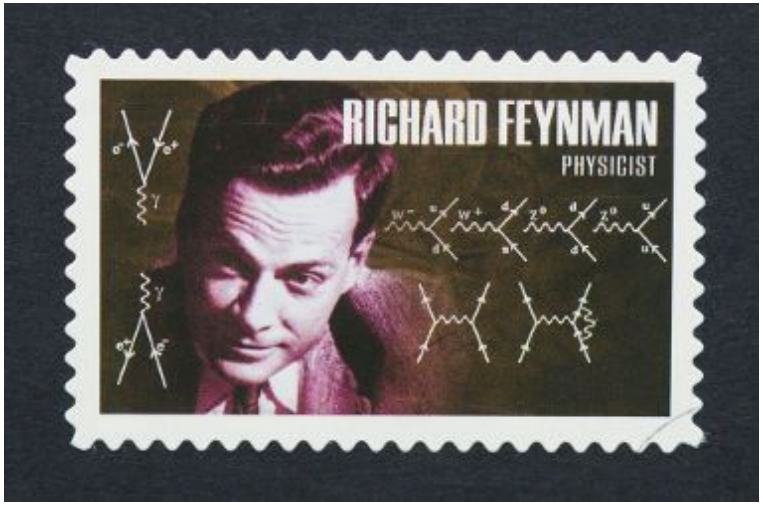
Vitória, 08 setembro de 2019

DIMENSÃO DO MUNDO: DO MACRO AO NANO



Escala manométrica referida ao diâmetro de diversos tipos de materiais: de um átomo de hidrogênio (H) ao tamanho do planeta Terra!

Richard Feynman (1959)



Nobel em 1965
Eletrôdinâmica Quântica

Físico norte-americano: richard Feynman (1918-1988)

- **Centro Brasileiro de Pesquisas Físicas (CBPF) - (1950)**
- **Universidade Federal do Rio de Janeiro (UFRJ)**

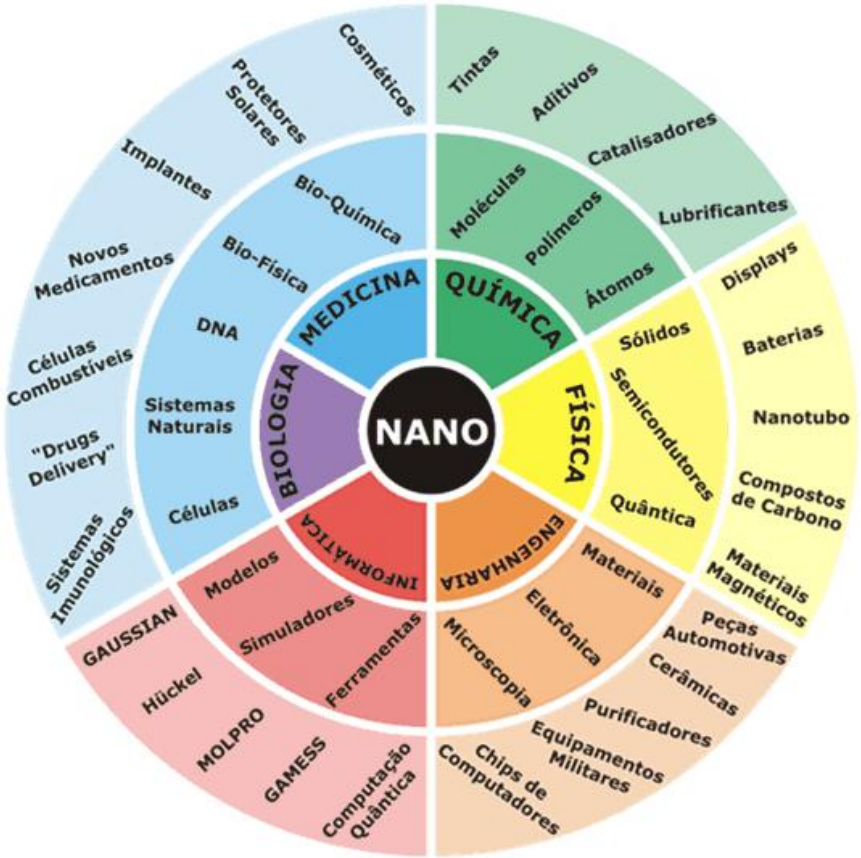
Numa palestra disse:
"Há muito mais espaço lá embaixo",
Desde a célebre frase de Richard Feynman – "há muito espaço lá embaixo", que é considerado por muitos como o nascimento da nanotecnologia.

Filme: Viagem Fantástica (1966)

Raquel Welch arrive at the premiere of Midler's movie, THE ROSE, 1979.

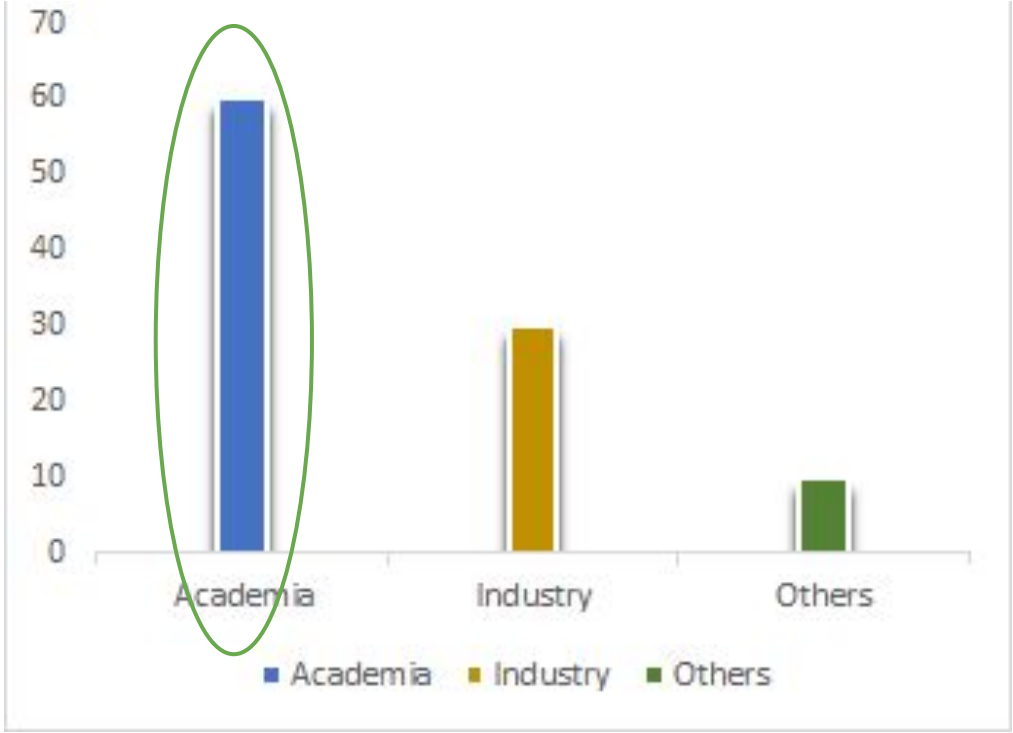
Cientistas norte-americanos embarcam em um **submarino miniaturizado** e injetado no corpo de **Jan Benes**, um colega de trabalho em coma. A equipe médica tem apenas uma hora para chegar **ao cérebro e drenar o coágulo**. Após isso, o submarino minúsculo vai começar a voltar ao tamanho normal, podendo ser detectado pelo sistema imunológico de Benes e possivelmente destruído. A delicada operação pode salvar a vida do cientista, que descobriu uma tecnologia de última geração antes do seu problema de saúde. O roteiro descreve um filme de ficção científica de 1966, **Viagem Fantástica**, que já anunciava princípios atuais da **Nanotecnologia.**

Áreas do conhecimento Nanoescala:



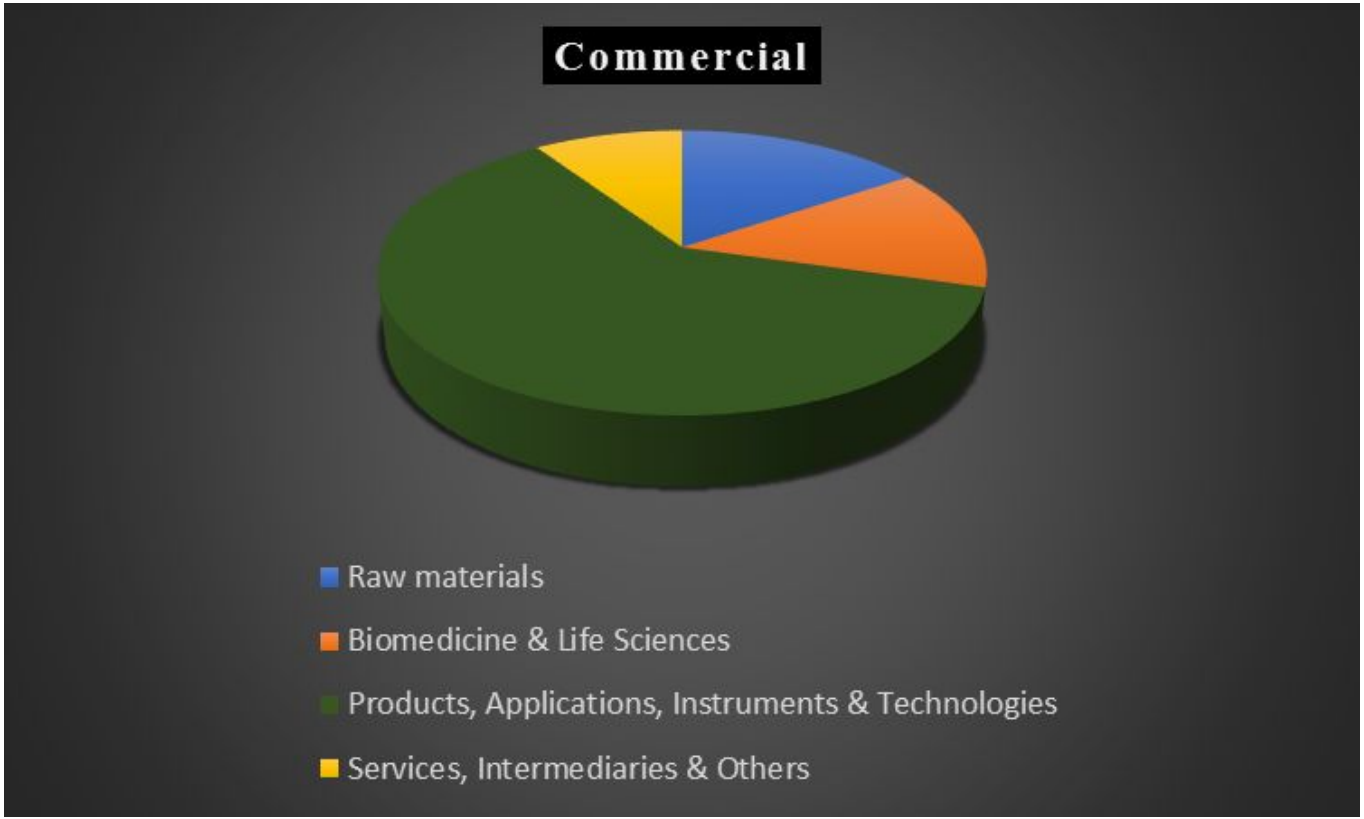
Nanociência e Sociedade = Economia

Interesse por NanoCiências?



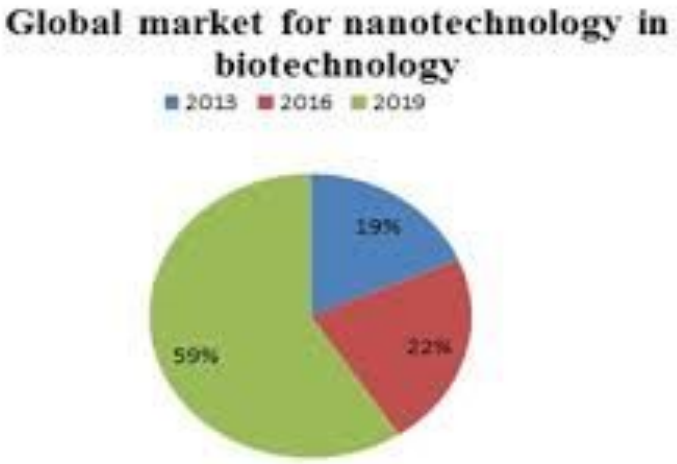
https://nanoscience.conferenceseries.com/

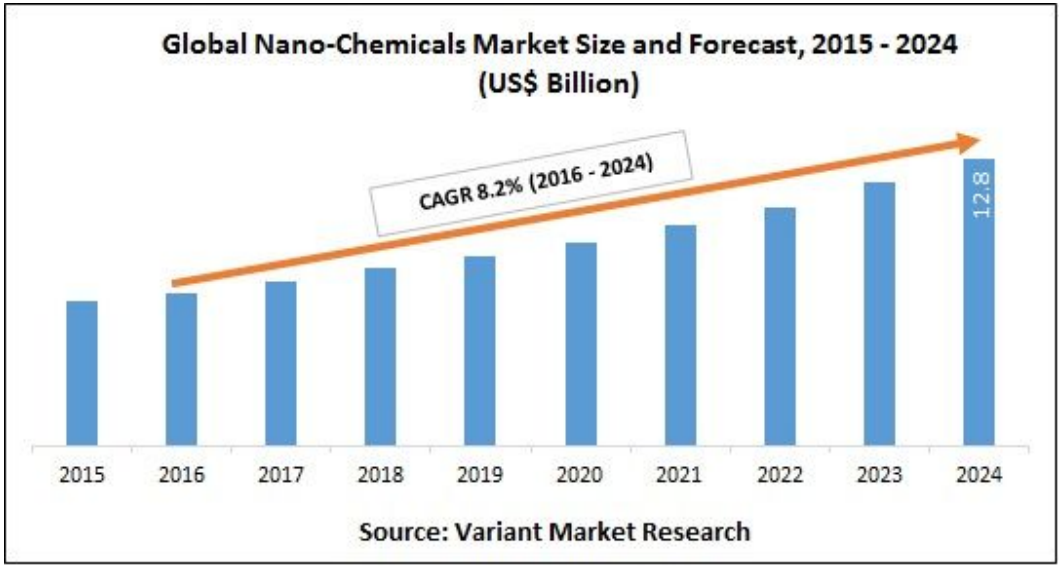
Mercado de Nanotecnologia



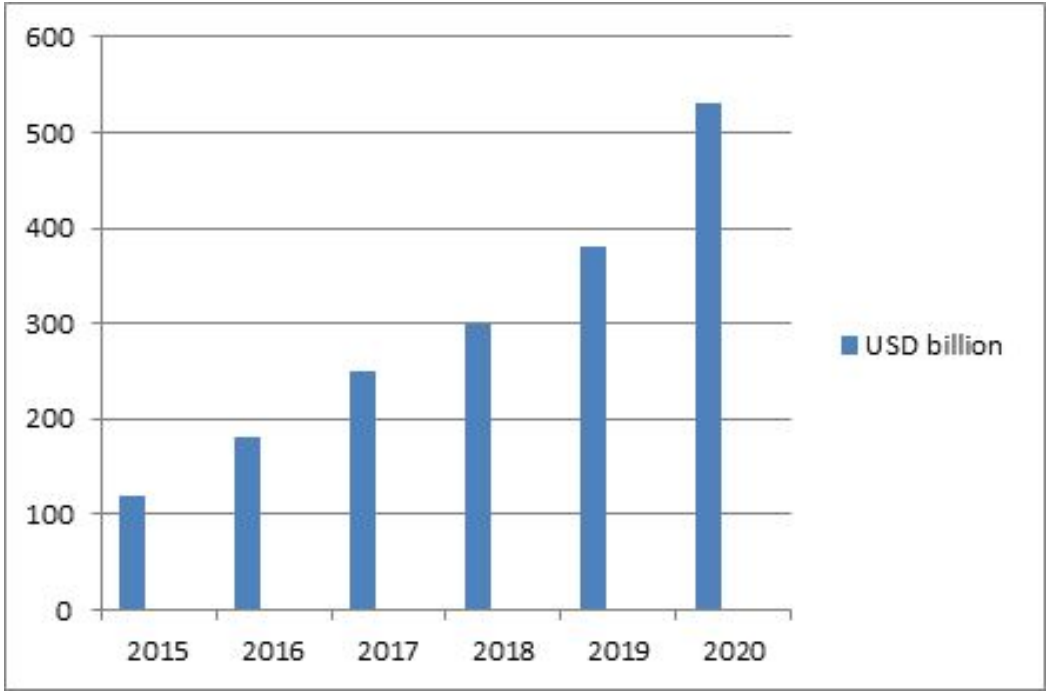
https://nanoscience.conferenceseries.com/

Mercado de Nanotecnologia:



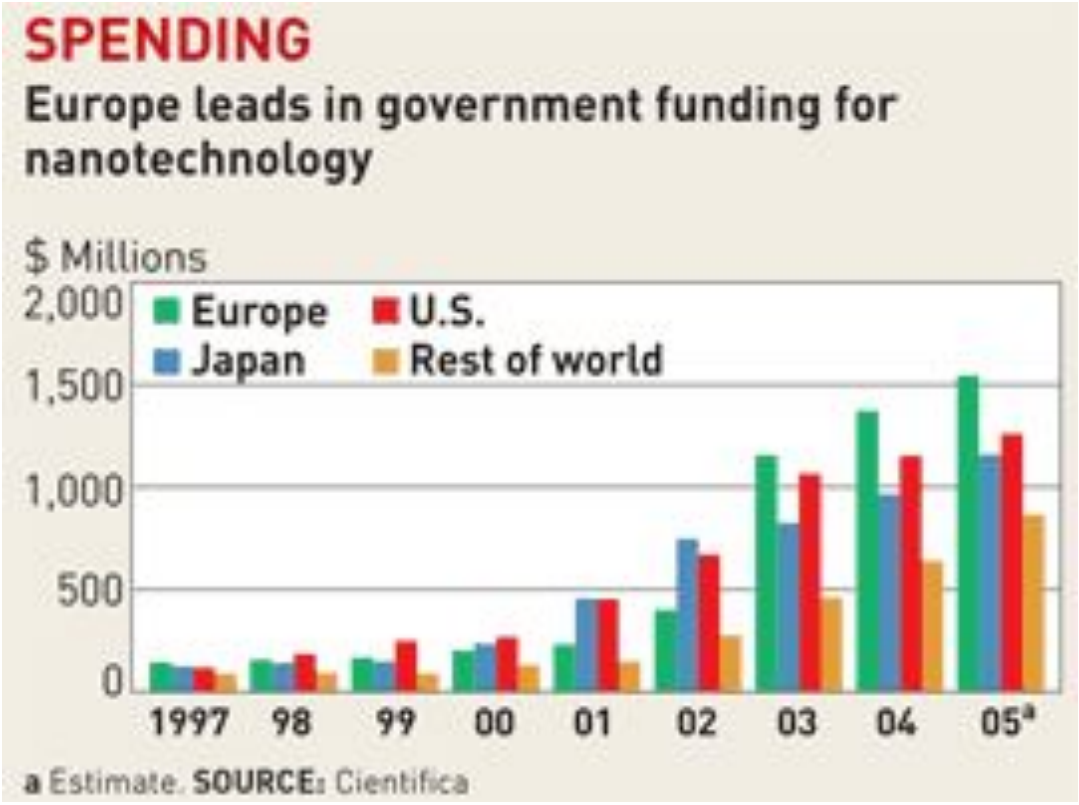


Crescimento no Mercado de Nanotecnologia



https://nanoscience.conferenceseries.com/

Investimentos em Nanotecnologia:



Patentes em Nanotecnologia:

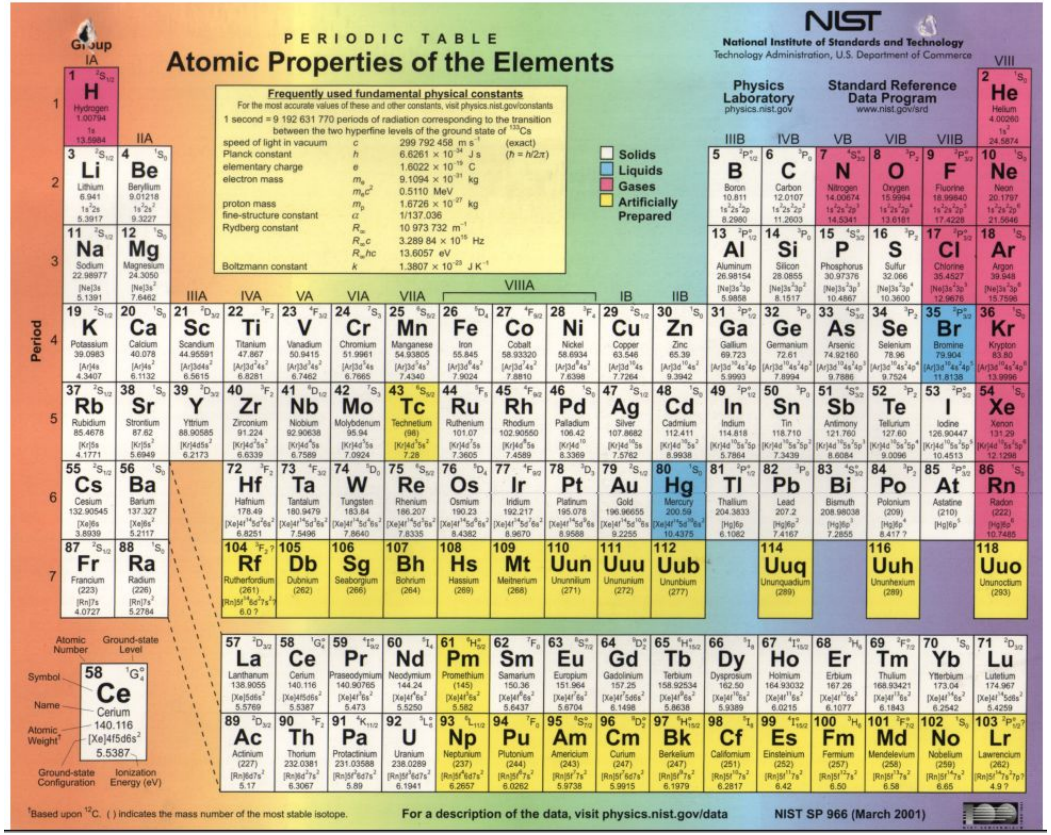
Table 4 Percentage of WIPO patent awards in five regions as compared to their sum

Year	US (%)	Japan (%)	EU27 (%)	P.R. China (%)	South Korea (%)	Sum WIPO patents %
2000	**43.40**	13.94	23.65	5.57	8.37	100 (2030)
2005	**32.31**	16.74	8.89	23.04	9.35	100 (11,313)
2010	27.57	10.59	7.58	**32.13**	10.91	100 (23,067)
2015	15.70	3.25	4.91	**61.78**	6.34	100 (42,822)

The largest percentage among regions per year is marked by bold fonts

J Nanopart Res (2017) 19: 370

Como manipular a matéria?



Materiais

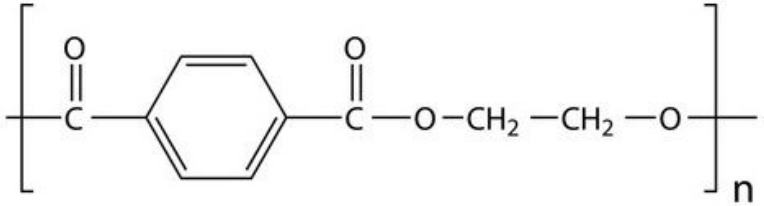
Aluminium - Metal

Glass - Ceramics

Plastic - Polymer

74 SiO_2, 13 Na_2O, 10.5 CaO, 1.3 Al_2O_3, 0.3 K_2O, 0.2 SO_3, 0.2 MgO, 0.01 TiO_2, 0.04 Fe_2O_3

Polyethylene terephthalate



- Mecânicas
- Óticas
- Térmicas
- Elétricas
- Magnéticas

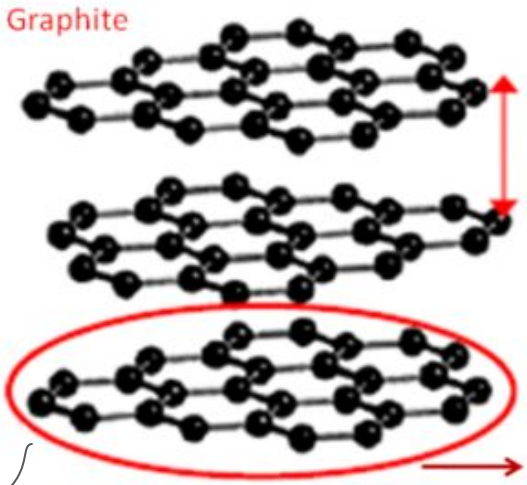
A familiar item that is fabricated from three different material types is the beverage container. Beverages are marketed in aluminum (metal) cans (top), glass (ceramic) bottles (center), and plastic (polymer) bottles (bottom). (Permission to use these photographs was granted by the Coca-Cola Company.)

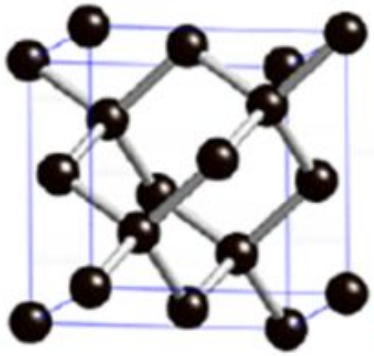
DIMENSÃO

Metal

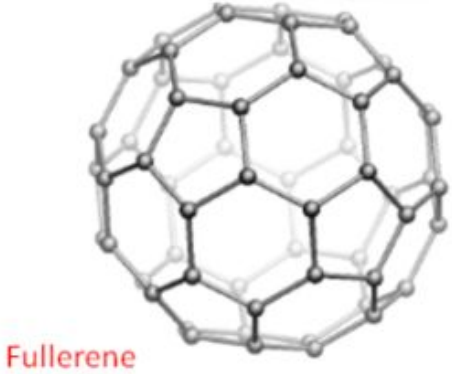
Geim and Novoselov received awards for their pioneering research on graphene, notably the 2010 Nobel Prize in Physics

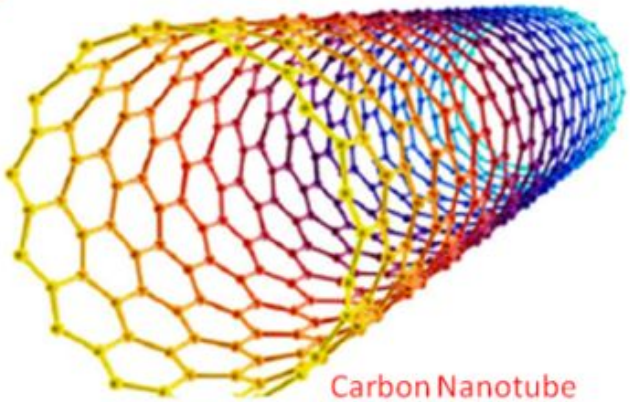
Isolante





Isolante

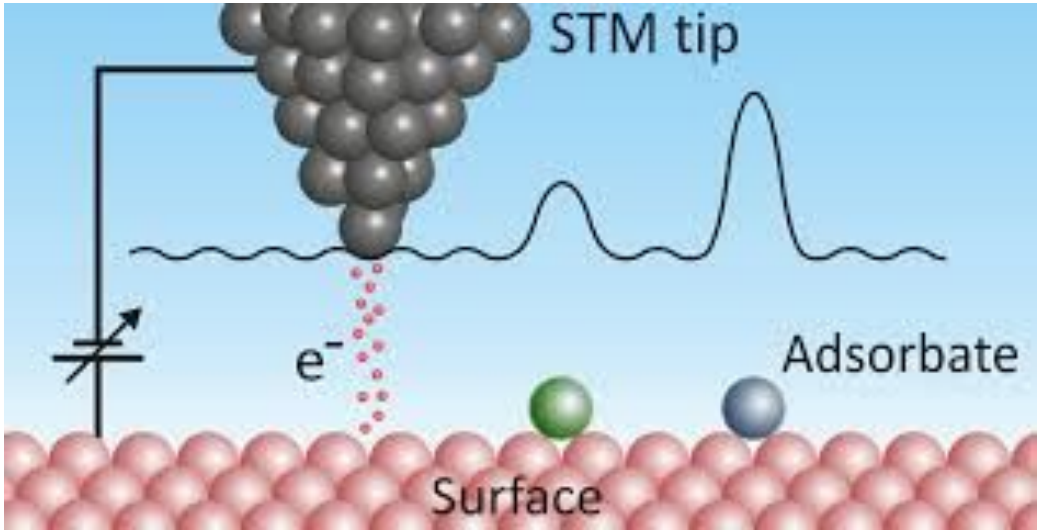


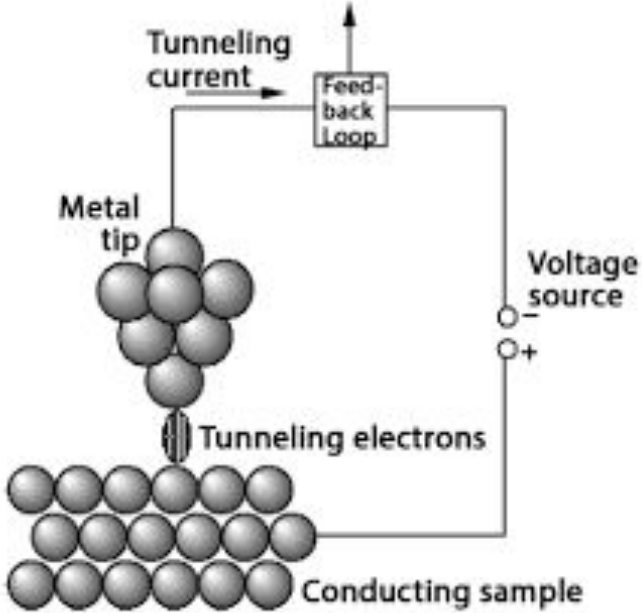


Manipulando átomo por átomo

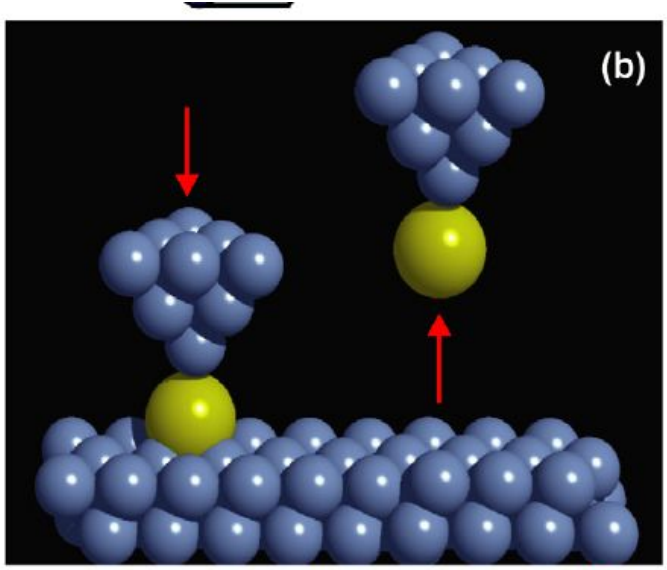
Scanning tunneling microscopy (STM)

Resolução: Lateral: 0,1 nm
Profundidade: 0,01 nm





Gerd Binnig and Heinrich Rohrer (at IBM Zürich), the Nobel Prize in Physics in 1986



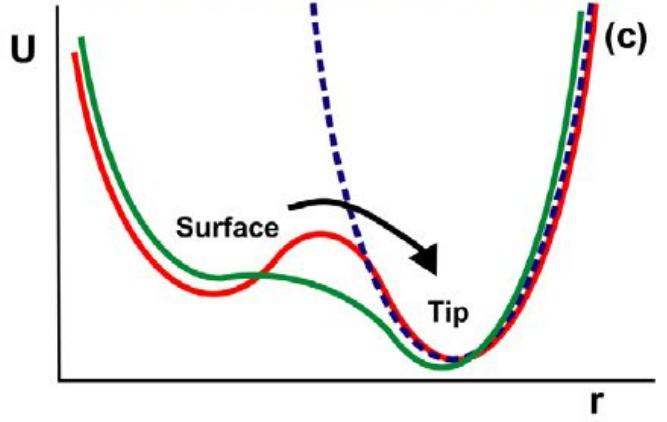
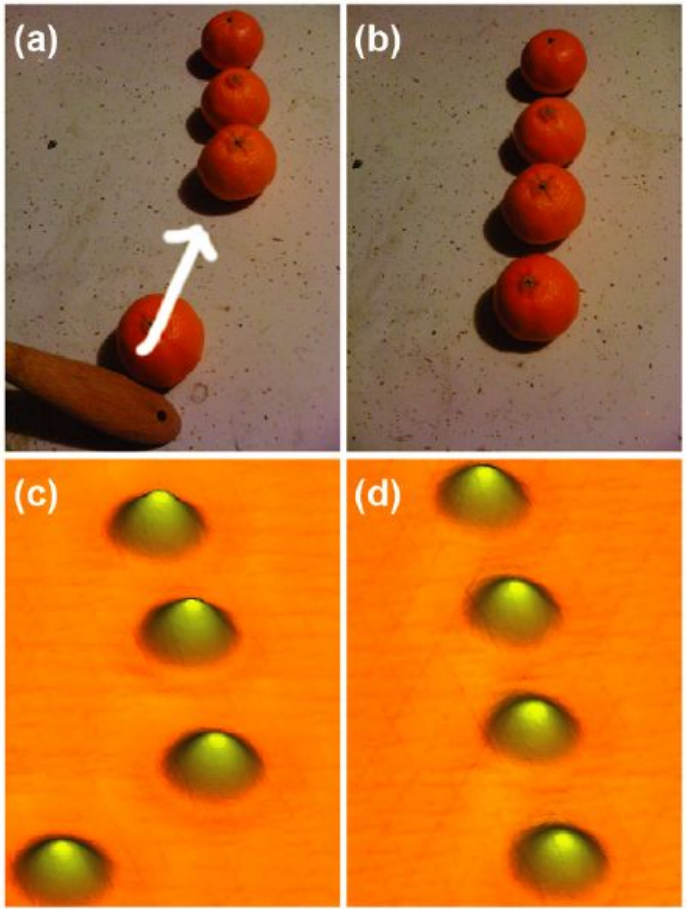
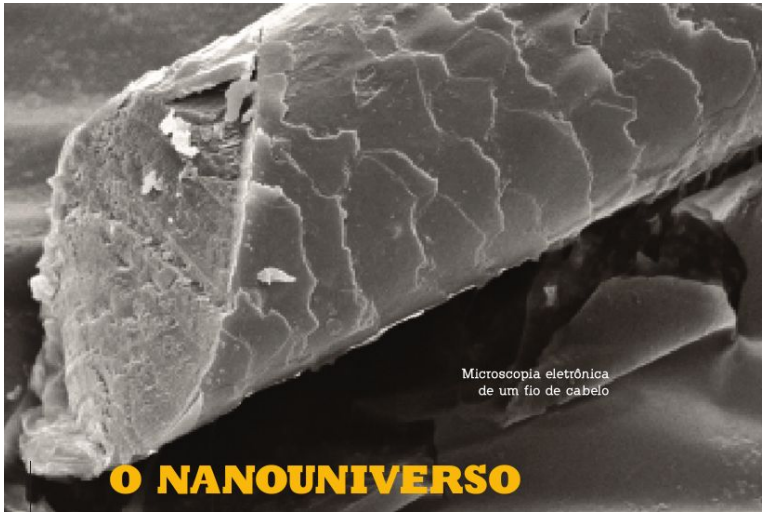


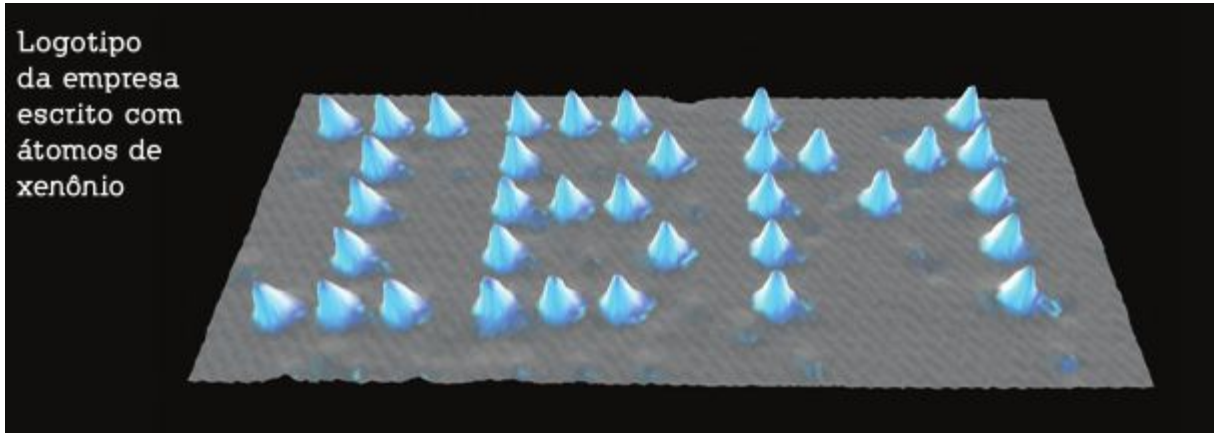
Figure 3. VM. Loading/unloading of a crane in (*a*) is analogous to the transfer of an atom between the tip and sample (*b*). (*c*) The double well potential (red) for two possible adsorption sites of the atom: on the surface and at the tip. A single well (dashed curve) is formed when the tip is in contact with the atom. When an electric field is applied, the barrier between the two wells is reduced (green).



Rep. Prog. Phys. **77** (2014) 056502

Figure 1. Orange and atom assembly. (*a*) An orange is laterally moved along the arrow by a wooden stick, and (*b*) an assembled line of four oranges. (*c*) Four silver atoms are laterally moved to assembled to form a line on Ag(1 1 1) (*d*).


Microscopia eletrônica
de um fio de cabelo
O NANOUNIVERSO

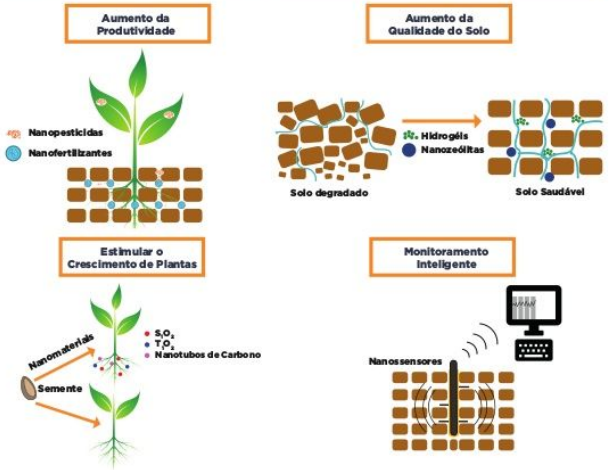

Logotipo
da empresa
escrito com
átomos de
xenônio

Onde aplicar Nanociência ?

Inovações tecnológicas

Agricultura:

Nanotecnologia & Agricultura



Aplicações da Nanotecnologia na Agricultura de Precisão

Fonte: Nanotechnology in Agriculture: Which Innovation Potential Does It Have?, DOI: 10.3389/fenvs.2016.00020.

Agricultura:

NanoPelícula com alta concentração de Nutriente

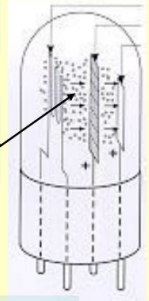
Produtor rural irá fazer apenas uma aplicação na lavoura.

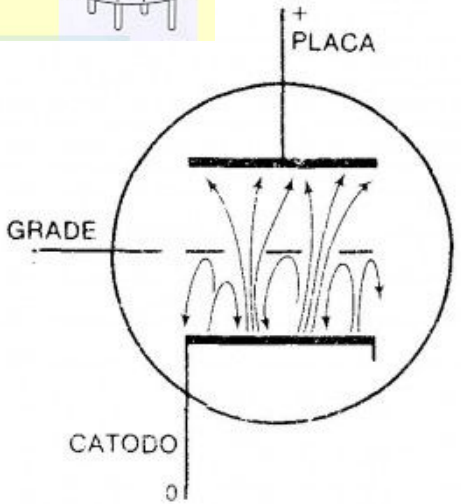
Fertilizantes

Indústria da Eletrônica:

(1907) De Forest inventa a válvula triodo

elétrons emitidos pelo catodo são acelerados para a placa por um campo elétrico

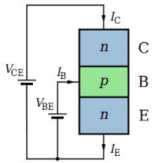


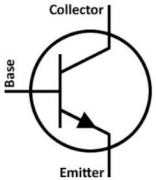


Sabe o que é isso?

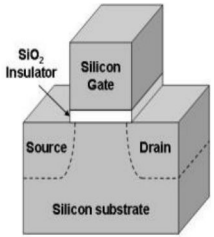
É um disco rigido de 5MB de 1956....
Em Setembro de 1956 a IBM lançou o 305 RAMAC, o primeiro Computador com Hard Disk (HDD)
O HDD pesava perto de 1 Tonelada e tinha a capacidade de 5Mb...
E você reclamando do seu PEN Drive de 4 GB, né?

Transistor (FETs)

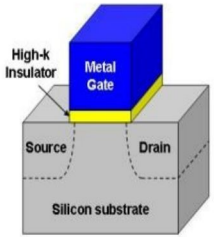


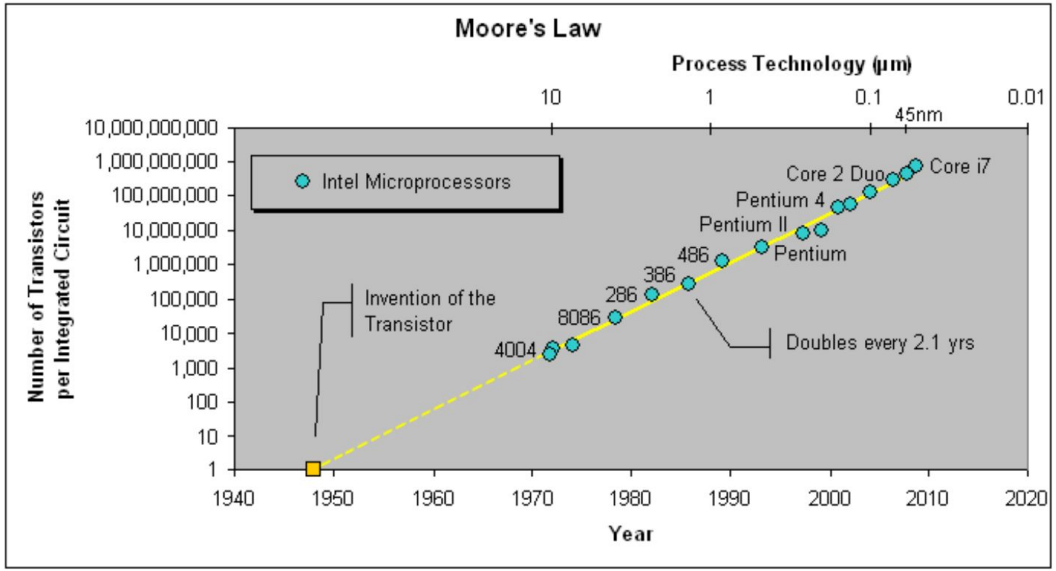


Standard Silicon Transistor

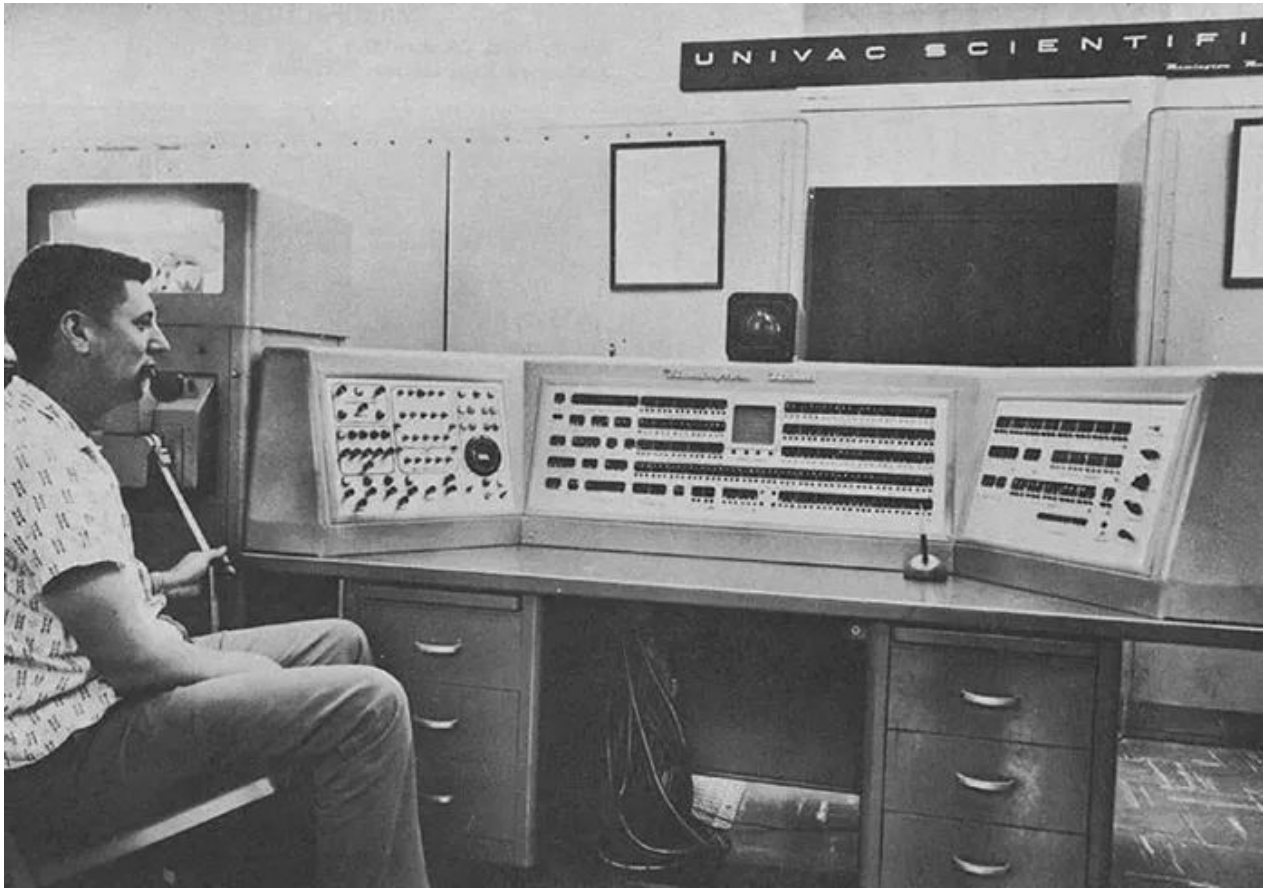


High-k + Metal Gate Transistor





Transistor (FETs): 1950

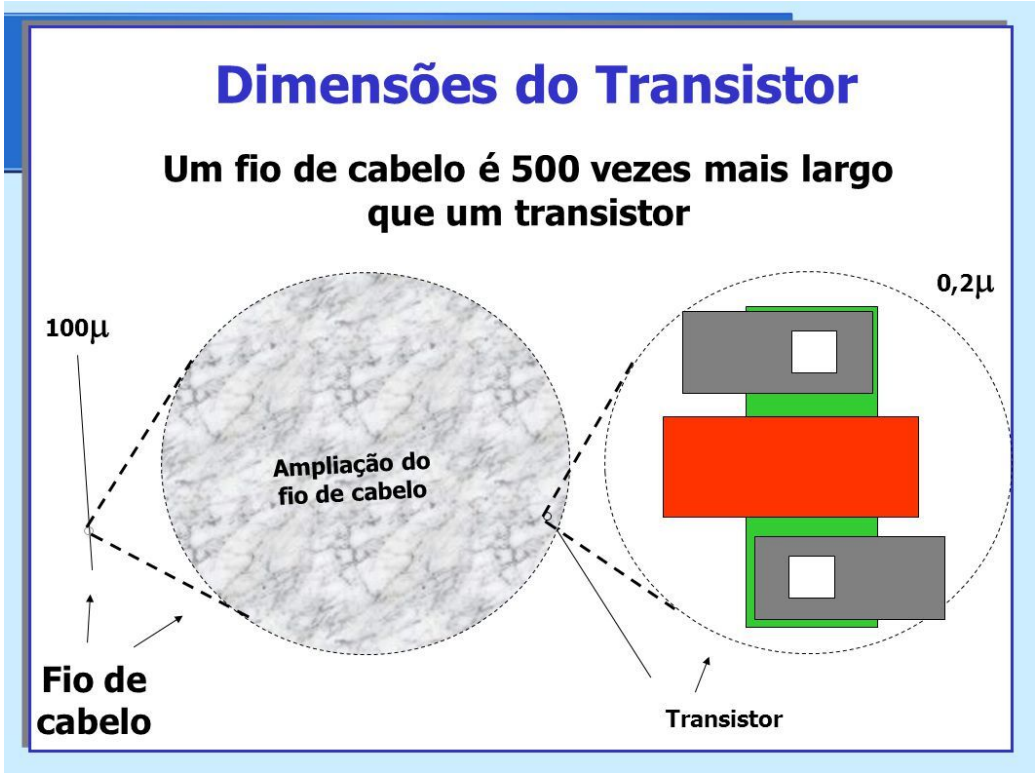


Univac 1101, modelo de sucesso com transistores, ocupava sala (Foto: Reprodução/Creative Commons)

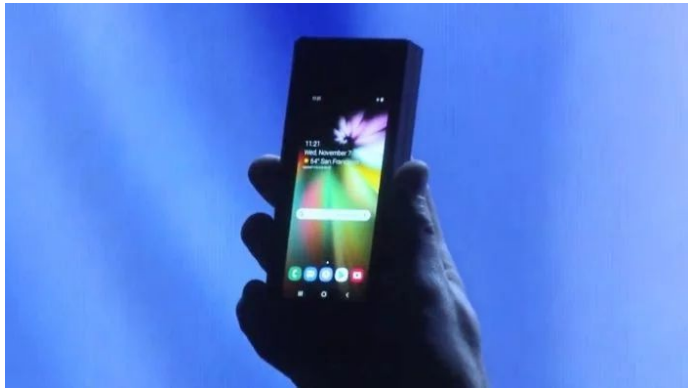
Comprimento = 12,0 m

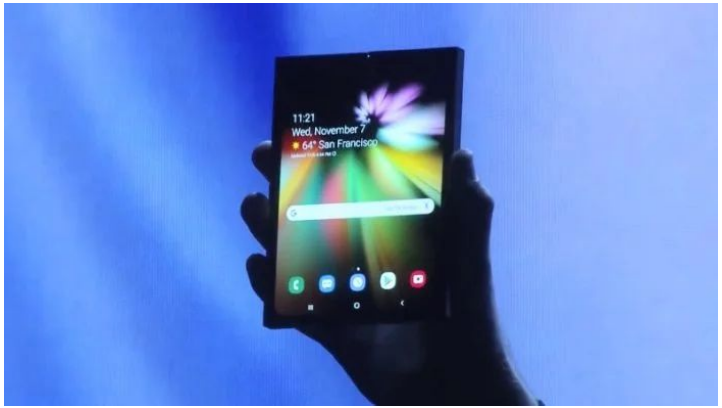
Largura: 6,1 m

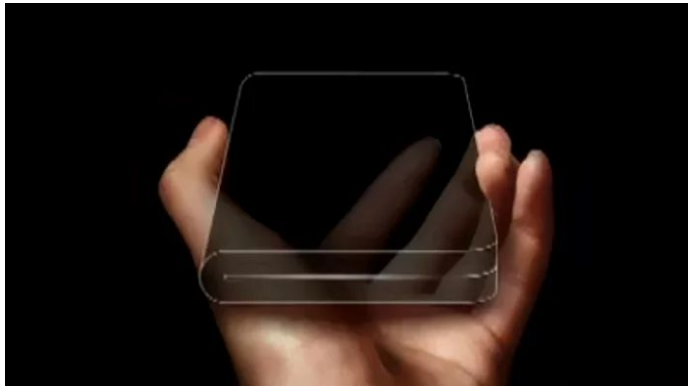
Transistor (FETs): Nos dias atuais

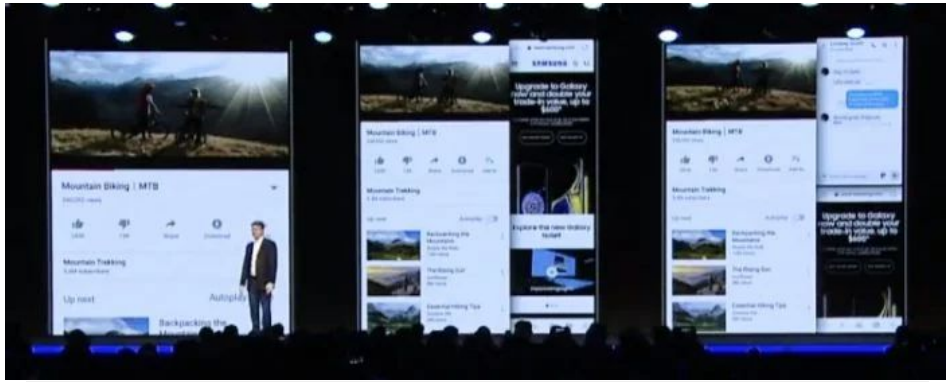


Samsung cria Infinity Flex e promete telas flexíveis









Celular dobrável da Samsung com um app, dois apps e três apps na tela

https://tecnoblog.net/266667/samsung-celular-dobravel-infinity-flex-oficial/

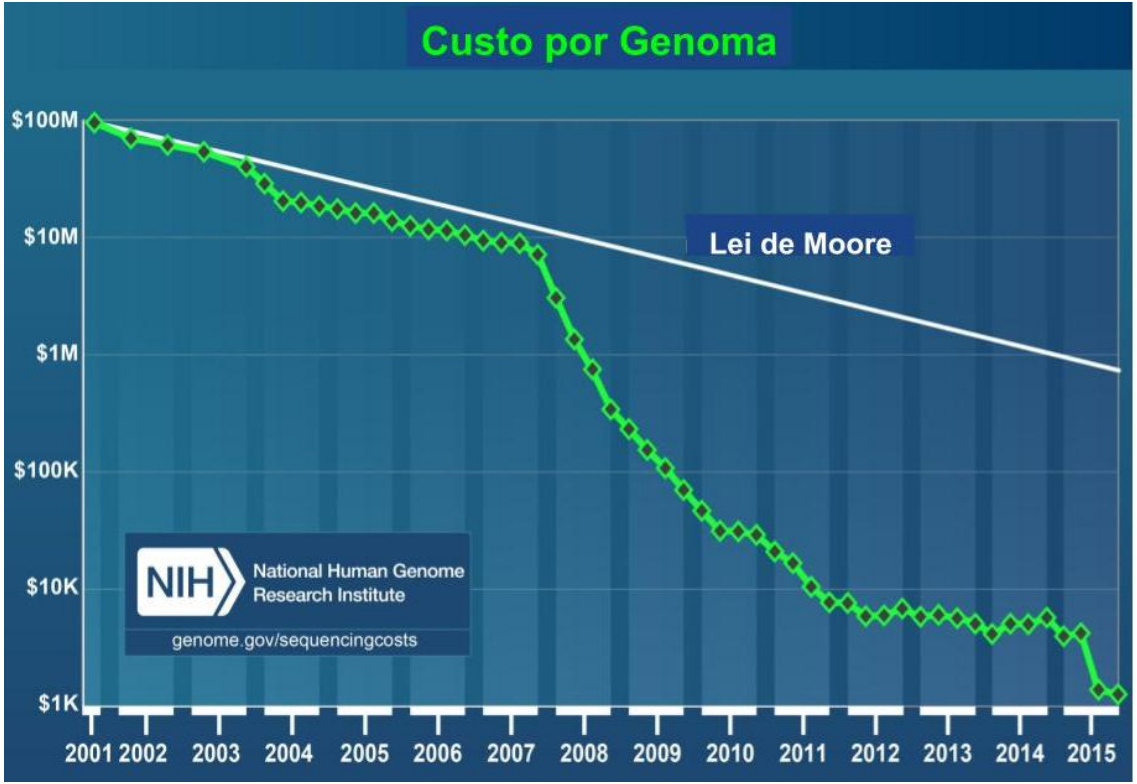
Biologia e Medicina:

Porque sequenciar o DNA(dyoxiribonucleic acid)?

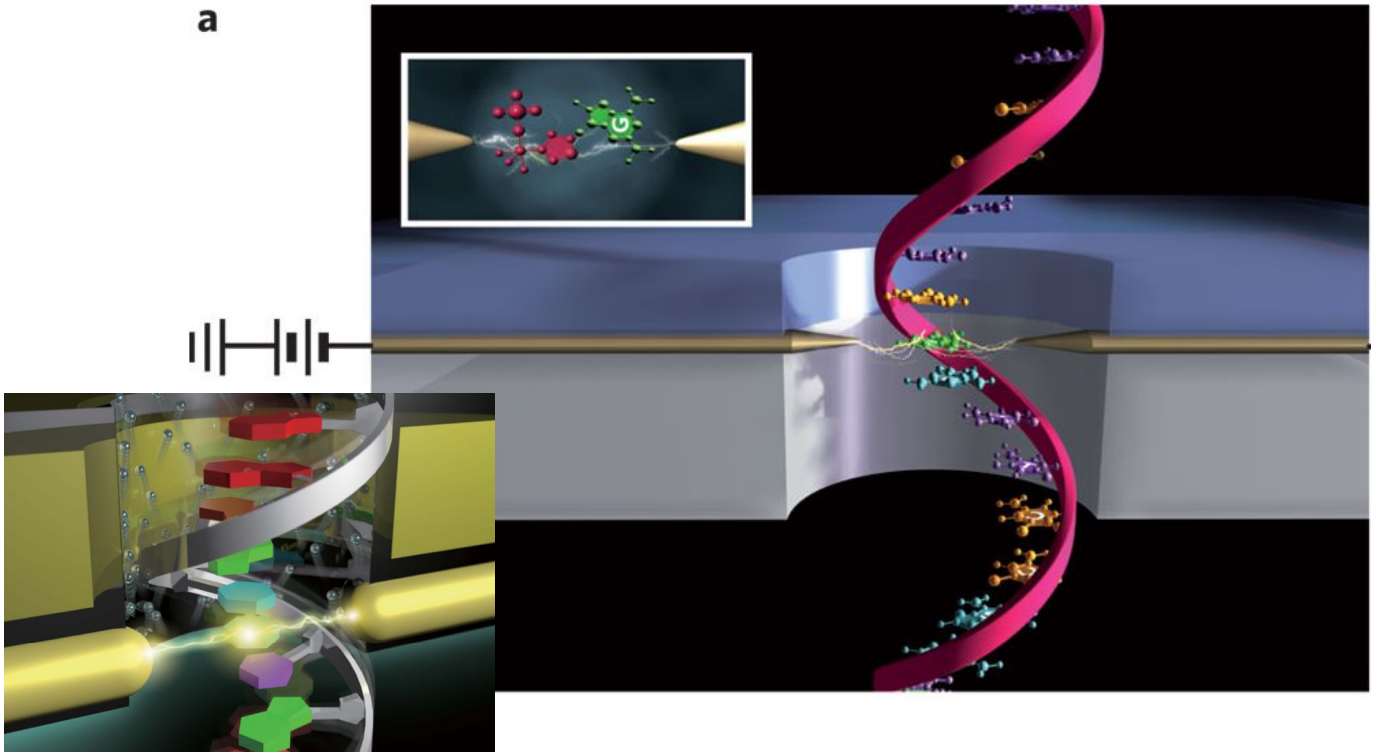
- ➢ Sequenciamento de um grande número de indivíduos:
  - ❑ Estudos estatísticos e comparações de genoma para analisar mutações e doenças hereditárias.
- ➢ Análise completa de genomas:
  - ❑ Novo nível de medicina preventiva.
- ➢ Padrões genéticos em sequências de DNA:
  - ❑ Determinar precisamente o risco de uma doença.
  - ❑ Medicina de precisão ou personalizada.

Custo para sequenciar DNA

- 2001-2007: Primeira Geração.
- 2008: Segunda Geração.
- 2014: Primeiro Sequenciador Baseado em Nanoporos.
- Nanoporos: Terceira Geração.



ALternativa para sequenciar DNA: Nanoporos !



Adenine

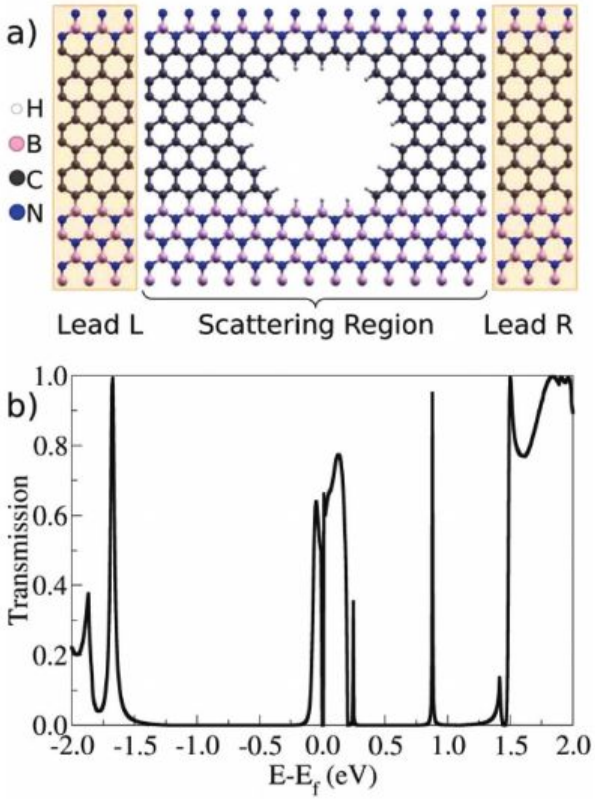
Guanine

Cytosine

Thymine


WORK IN PROGRESS

Desenvolvimento na Ufes -Sequenciamento de DNA



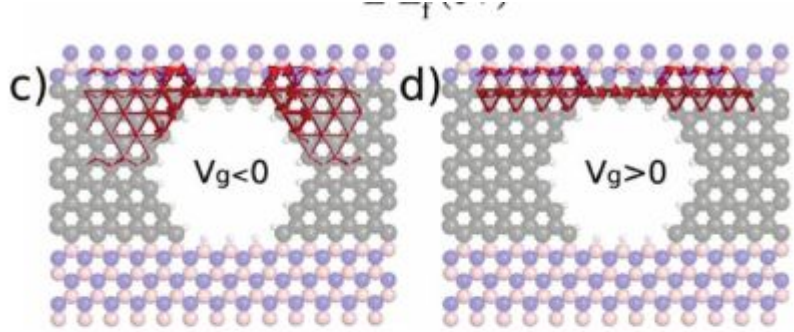


Fig. 1 For the Single Modulation Device (SMD) we show here: (a) device setup, further described in the main text; (b) the zero-bias transmission spectrum; representative examples of local currents (transmission projection between two adjacent sites) for negative (c) and positive (d) gate voltages, respectively. Specifically, plots show local currents for V_g = −0.1 V and V_g = +0.1 V. The red arrows represent the transmittance projection and their intensities are proportional to the arrows' thickness.

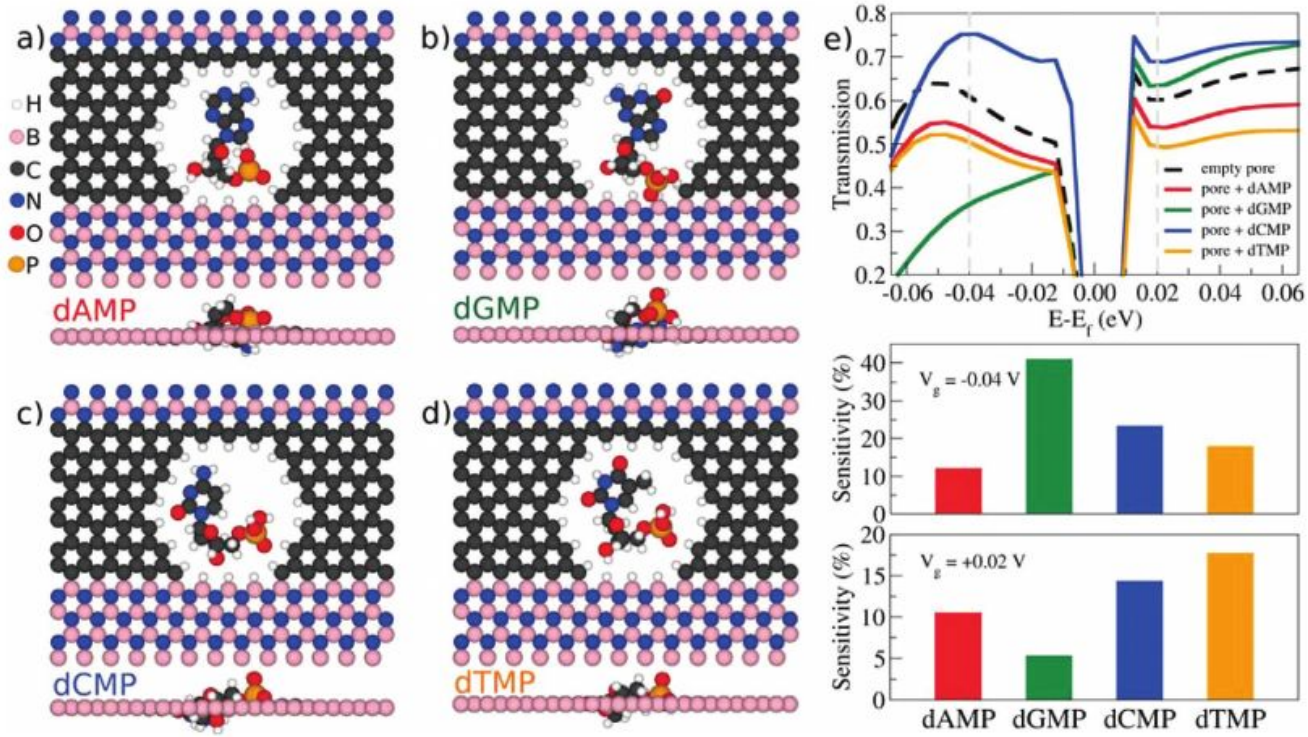
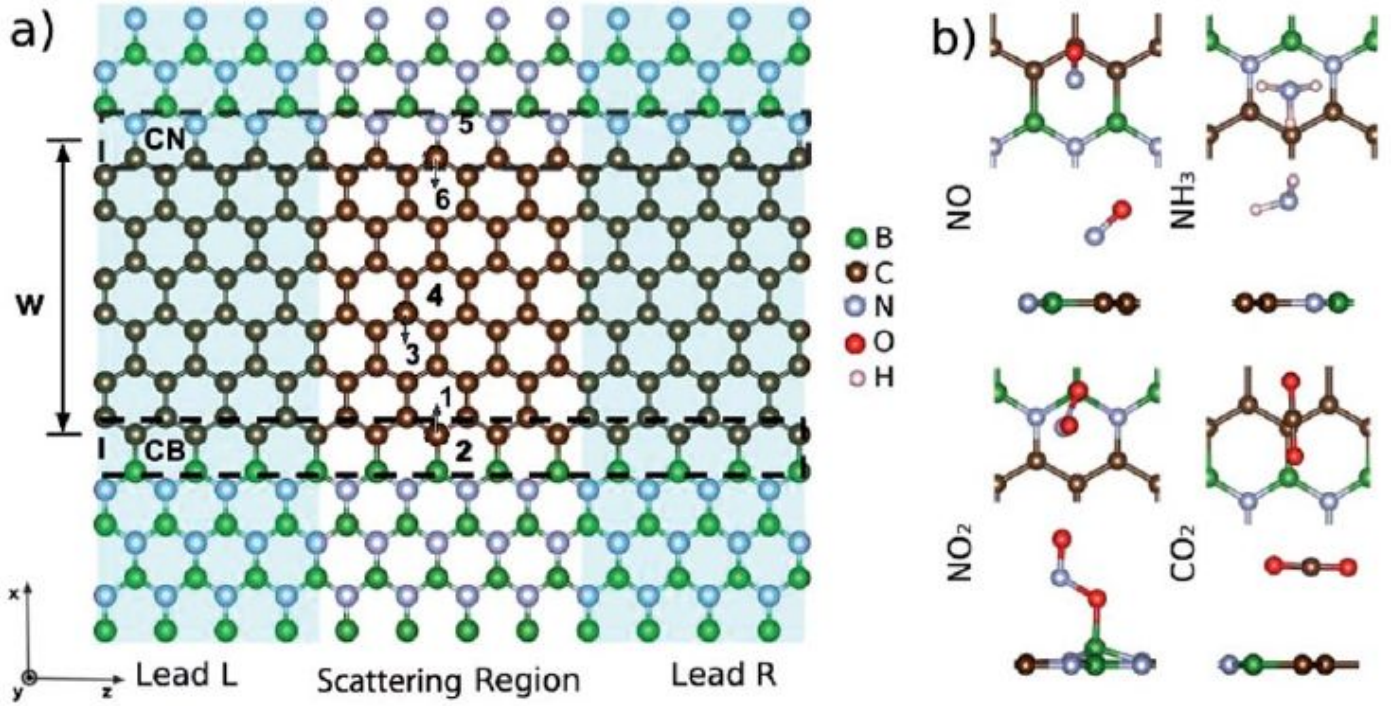


Fig. 2 For the SMD we show here: (a–d) top and side views of the fully relaxed structures of the pore containing either dAMP, dGMP, dCMP, or dTMP, respectively; (e) zero-bias transmission spectra in the vicinity of the Fermi level for the empty pore and the pore filled (top panel) and sensitivity histograms at two different gate voltages for dAMP, dGMP, dCMP, and dTMP (bottom panels) with the empty pore as the reference.

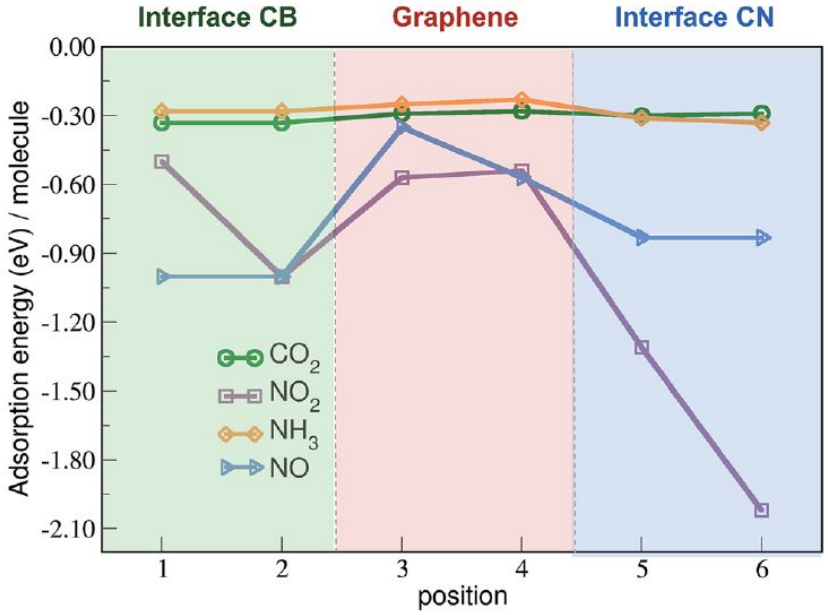
Electrical detection of nucleotides via nanopores in a hybrid graphene/h-BN sheet

FAL de Souza, RG Amorim, WL Scopel, RH Scheicher - Nanoscale 9 (6), 2207-2212 15 (2017)

Desenvolvimento na Ufes - Nanosensor de Gases



Desenvolvimento na Ufes (Nanosensor)



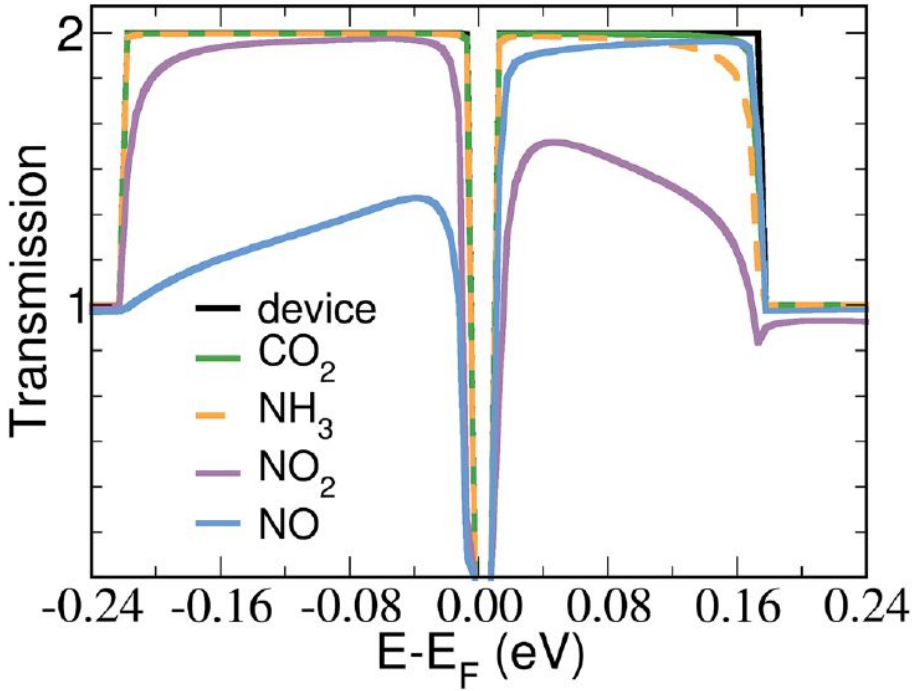
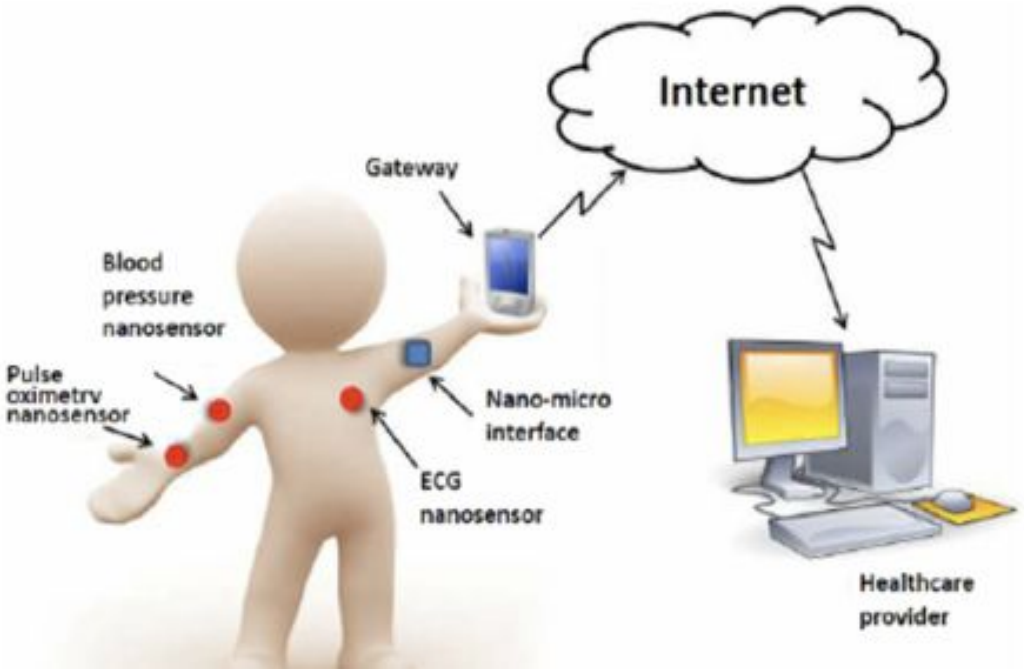


Fig. 2 The adsorption energy of the four molecules for three different regions (six positions) on top of the hybrid system. The considered positions are labelled in Fig. 1a.

Integração da Internet e Nanocoisas



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Muito Obrigado pela Atenção!

Suporte Financeiro