Timeline of carbon nanotubes

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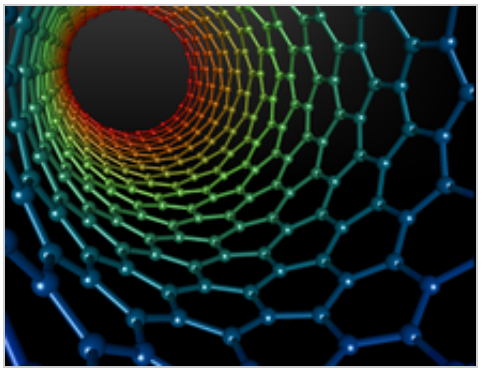
1952

- Radushkevich and Lukyanovich publish a paper in the Soviet *Journal of Physical Chemistry* showing hollow graphitic carbon fibers that are 50 nanometers in diameter.[1]



Inside a carbon nanotube

1960

- Bollmann and Spreadborough discuss friction properties of carbon due to rolling sheets of graphene in Nature. Electron Microscope picture clearly shows MWCNT[2]

1976

- Oberlin, Endo and Koyama report CVD (Chemical Vapor Deposition) growth of nanometer-scale carbon fibers.[3]

1979

- Arthur C. Clarke's science fiction novel *The Fountains of Paradise* popularizes the idea of a space elevator using "*a continuous pseudo-one dimensional diamond crystal*".[4]

1985

- Fullerenes discovered.[5]

1987

- Howard G. Tennent of Hyperion Catalysis issued a U.S. patent for graphitic, hollow core "fibrils".[6]

1991

- Nanotubes discovered in the soot of arc discharge at NEC, by Japanese researcher Sumio Iijima.[7]
- August — Nanotubes discovered in CVD by Al Harrington and Tom Maganas of Maganas Industries, leading to development of a method to synthesize monomolecular thin film nanotube coatings.[8]

1992

- First theoretical predictions of the electronic properties of single-walled carbon nanotubes by groups at Naval Research Laboratory, USA;[9] Massachusetts Institute of Technology;[10] and NEC Corporation[11]

1993

- Groups led by Donald S. Bethune (http://domino.research.ibm.com/comm/research_people.nsf/pages/bethune.index.html) at IBM[12] and Sumio Iijima at NEC[13] independently discover single-wall carbon nanotubes and methods to produce them using transition-metal catalysts.

1995

- Swiss researchers are the first to demonstrate the electron emission properties of carbon nanotubes.[14] German inventors Till Keesmann and Hubert Grosse-Wilde predicted this property of carbon nanotubes earlier in the year in their patent application.[15]

1997

- First carbon nanotube single-electron transistors (operating at low temperature) are demonstrated by groups at Delft University[16] and UC Berkeley.[17]
- The first suggestion of using carbon nanotubes as optical antennas is made in the patent application of inventor Robert Crowley filed in January 1997.[18]

1998

- First carbon nanotube field-effect transistors are demonstrated by groups at Delft University[19] and IBM.[20]

2000

- First demonstration proving that bending carbon nanotubes changes their resistance[21]

2001

- April — first report on a technique for separating semiconducting and metallic nanotubes.[22]

2002

- January — Multi-walled nanotubes demonstrated to be fastest known oscillators (> 50 GHz).[23]

2003

- September — NEC announced stable fabrication technology of carbon nanotube transistors[24]

2004

- March — Nature published a photo of an individual 4 cm long single-wall nanotube (SWNT).[25]

2005

- May — A prototype high-definition 10-centimetre flat screen made using nanotubes was exhibited.[26]
- August — University of California finds Y-shaped nanotubes to be ready-made transistors.[27]
- August — General Electric announced the development of an ideal carbon nanotube diode that operates at the "theoretical limit" (the best possible performance). A photovoltaic effect was also observed in the nanotube diode device that could lead to breakthroughs in solar cells, making them more efficient and thus more economically viable.[28]
- August — Nanotube sheet synthesised with dimensions 5 × 100 cm.[29]

2006

- March — IBM announces that they have built an electronic circuit around a CNT.[30]
- March — Nanotubes used as a scaffold for damaged nerve regeneration.[31]
- May — Method of placing nanotube accurately is developed by IBM.[32]
- June — Gadget invented by Rice University that can sort nanotubes by size and electrical properties[33]
- July — Nanotubes were alloyed into the carbon fiber bike that won the 2006 Tour de France.[34]

The winning nanotube-enhanced bike

2009

- April — Nanotubes incorporated in virus battery[35]

2012

- January — IBM creates 9nm carbon nanotube transistor that outperforms silicon[36]

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