"Истоки" Нанотехнологии

Преподаватель : ***Москалец Михаил Васильевич***

(кафедра ФМП)

Группа : **ФТ-18**

'Nano-technology' mainly consists of the processing of separation, consolidation, and deformation of materials by one atom or one molecule.

Norio Taniguchi (谷口 紀男), 1974 г.

Nano :

Нано происходит от греческого

νάνος [нанос] – карлик

Китайсткий :

Нано	納米	[нами]
Рис	大米	[тами]

Японский :

Нано ナノ

Atom :

Атом происходит от греческого

ἄτομος [томос] – неделимый

Leucippus

Leucippus

Full name	Leucippus
Born	Early 5th century BCE Abdera or Miletus
Died	5th century BCE
Era	Pre-Socratic philosophy
Region	Western Philosophy
School	Pre-Socratic philosophy: Atomism, Materialism
Main interests	Metaphysics
Notable ideas	Atomism

Democritus

Democritus

Full name	Democritus
Born	ca. 460 BC Abdera, Thrace
Died	ca. 370 BC (Aged 90)
Era	Pre-Socratic philosophy
Region	Western Philosophy
School	Pre-Socratic philosophy
Main interests	metaphysics / mathematics / astronomy
Notable ideas	atomism, distant star theory

Одно из первых приспособлений малого размера...

Acupuncture

From Wikipedia, the free encyclopedia

Acupuncture is a type of alternative medicine that treats patients by insertion and manipulation of solid, generally thin needles in the body.

Through its origins, acupuncture has been embedded in the concepts of Traditional Chinese medicine (TCM). Its general theory is based on the premise that bodily functions are regulated by the flow of an energy-like entity called qi. Acupuncture aims to correct imbalances in the flow of qi by stimulation of anatomical locations on or under the skin called acupuncture points, most of which are connected by channels known as meridians. Scientific research has not found any physical or biological correlate of qi, meridians and acupuncture points,[1][2][3][4][5] and some contemporary practitioners needle the body without using a theoretical framework, instead selecting points based on their tenderness to pressure.[6]

The earliest written record of acupuncture is found in the Huangdi Neijing (黄帝内经; translated as *The Yellow Emperor's Inner Canon*), **dated approximately 200 BCE**

Acupuncture

Intervention

Needles being inserted into a patient's skin.

Прежде чем построить надо увидеть...

Timeline of microscope technology

From Wikipedia, the free encyclopedia

Timeline of microscope technology

- 1590 - Dutch spectacle-makers Hans Jansen and his son Zacharias Jansen, claimed by later writers (Pierre Borel 1620 - 1671 or 1628 – 1689 and Willem Boreel 1591 – 1668) to have invented a compound microscope.
- 1609 - Galileo Galilei develops a compound microscope with a convex and a concave lens.
- 1612 - Galileo presents *occhiolino* to Polish king Sigismund III.
- 1619 - Cornelius Drebbel (1572 – 1633) presents, in London, a compound microscope with two convex lenses.
- c.1622 - Drebbel presents his invention in Rome.
- 1624 - Galileo presents his *occhiolino* to Prince Federico Cesi, founder of the *Accademia dei Lincei* (in English, *The Linceans*). puta
- 1625 - Giovanni Faber of Bamberg (1574 - 1629) of the Linceans coins the word *microscope* by analogy with *telescope*.
- 1665 - Robert Hooke publishes *Micrographia*, a collection of biological micrographs. He coins the word *cell* for the structures he discovers in cork bark.
- 1674 - Anton van Leeuwenhoek improves on a simple microscope for viewing biological specimens.

1852 microscope

Timeline of micros

From Wikipedia, the free encyclopedia

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Zacharias Jansen

Zacharias Jansen

Born	1580 The Hague
Died	1638 (aged 57–58)
Citizenship	Dutch

1852 microscope

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Galileo Galilei

Portrait of Galileo Galilei by Giusto Sustermans

Born	15 February 1564[1] Pisa,[1] Duchy of Florence, Italy
Died	8 January 1642 (aged 77)[1] Arcetri,[1] Grand Duchy of Tuscany, Italy
Residence	Grand Duchy of Tuscany, Italy
Nationality	Italian (Tuscan)

1852 microscope

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Antonie van Leeuwenhoek

Portrait of Antonie van Leeuwenhoek (1632–1723) by Jan Verkolje

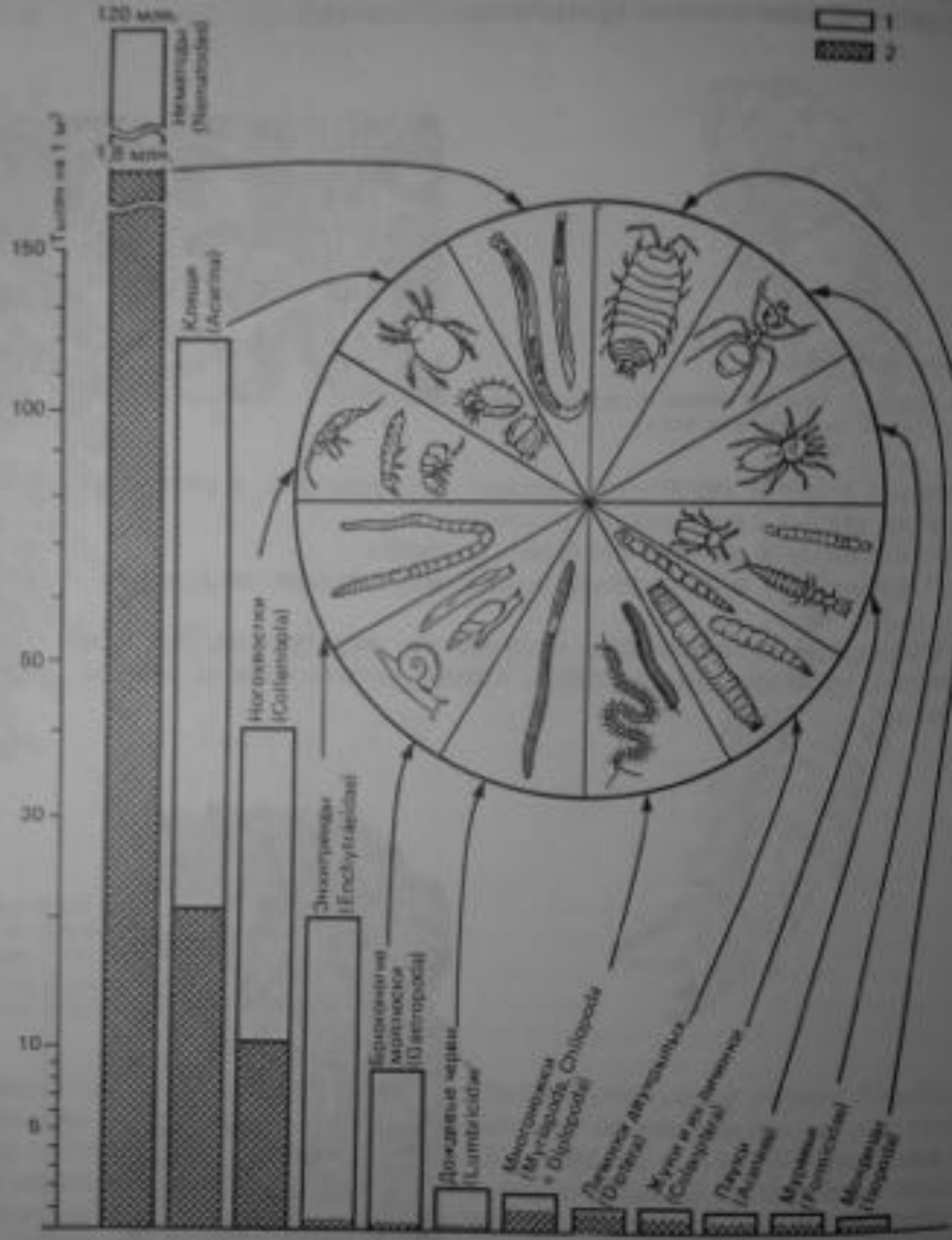
Born	October 24, 1632 Delft, Netherlands
Died	August 26, 1723 (aged 90) Delft, Netherlands
Residence	Netherlands
Nationality	Dutch
Fields	Microscopist and Biologist

1852 microscope

И что же мы увидели?

Таблица 1. **Приблизительное число и вес важнейших групп растений и животных, населяющих почвы Европы (в пересчете на блок с площадью 1 м² и глубиной 30 см) (по Dunger, 1970)**

Группы	Число организмов		Вес в граммах	
	среднее	оптимальное	средний	максимальный
Микрофлора (мельчайшие растительные организмы)			50	500
Бактерии	1 бли.	1000 бли.	50	500
Актиномицеты	10 млрд.	10 бли.	50	500
Грибы	1 млрд.	1 бли.	100	1000
Водоросли	1 млн.	10 млрд.	1	15
Микрофауна (0,002–0,2 мм)				
Жгутиковые (*Flagellata*)	0,5 бли.	1 бли.	10	100
Корненожки (*Rhizopoda*)	0,1 бли.	0,5 бли.		
Инфузории (*Ciliata*)	1 млн.	100 млн.		
Мезофауна (0,2–2,0 мм)				
Коловратки (*Rotatoria*)	25 тыс.	600 тыс.	0,01	0,3
Нематоды (*Nematoda*)	1 млн.	20 млн.	1	20
Клещи (*Acarina*)	100 тыс.	400 тыс.	1	10
Ногохвостки (*Collembola*)	50 тыс.	400 тыс.	0,6	10
Макрофауна (2–20 мм)				
Энхитреиды (*Enchitraeidae*)	10 тыс.	200 тыс.	2	26
Моллюски (*Gastropoda*)	50	1000	1	30
Пауки (Araneae)	50	200	0,2	1
Мокрицы (*Isopoda*)	50	200	0,5	1,5
Двупарноногие (*Diplopoda*)	150	500	4	8
Губоногие (*Chilopoda*)	50	300	0,4	2
Прочие многоножки (*Myriapoda*)	100	2000	0,05	1
Жуки и их личинки *Coleoptera*)	100	600	1,5	20
Двукрылые (личинки) (*Diptera*)	100	1000	1	10
Прочие насекомые	150	15000	1	15
Мегафауна (20–200 мм)				
Дождевые черви (Lumbricidae)	80	800	40	400
Позвоночные (*Vertebrata*)	0,001	0,1	0,1	10



Плотность населения европейской луговой почвы (на 1 м²) до глубины около 30 см.

1 - максимум; *2* - минимум.

Природа отдает предпочтение “наномашинам” ! (наноорганизмам)

“Русские” истоки нанотехнологии

Николай Лесков

Портрет Николая Лескова работы Валентина Серова, 1894 год.

«Левша»

[править]

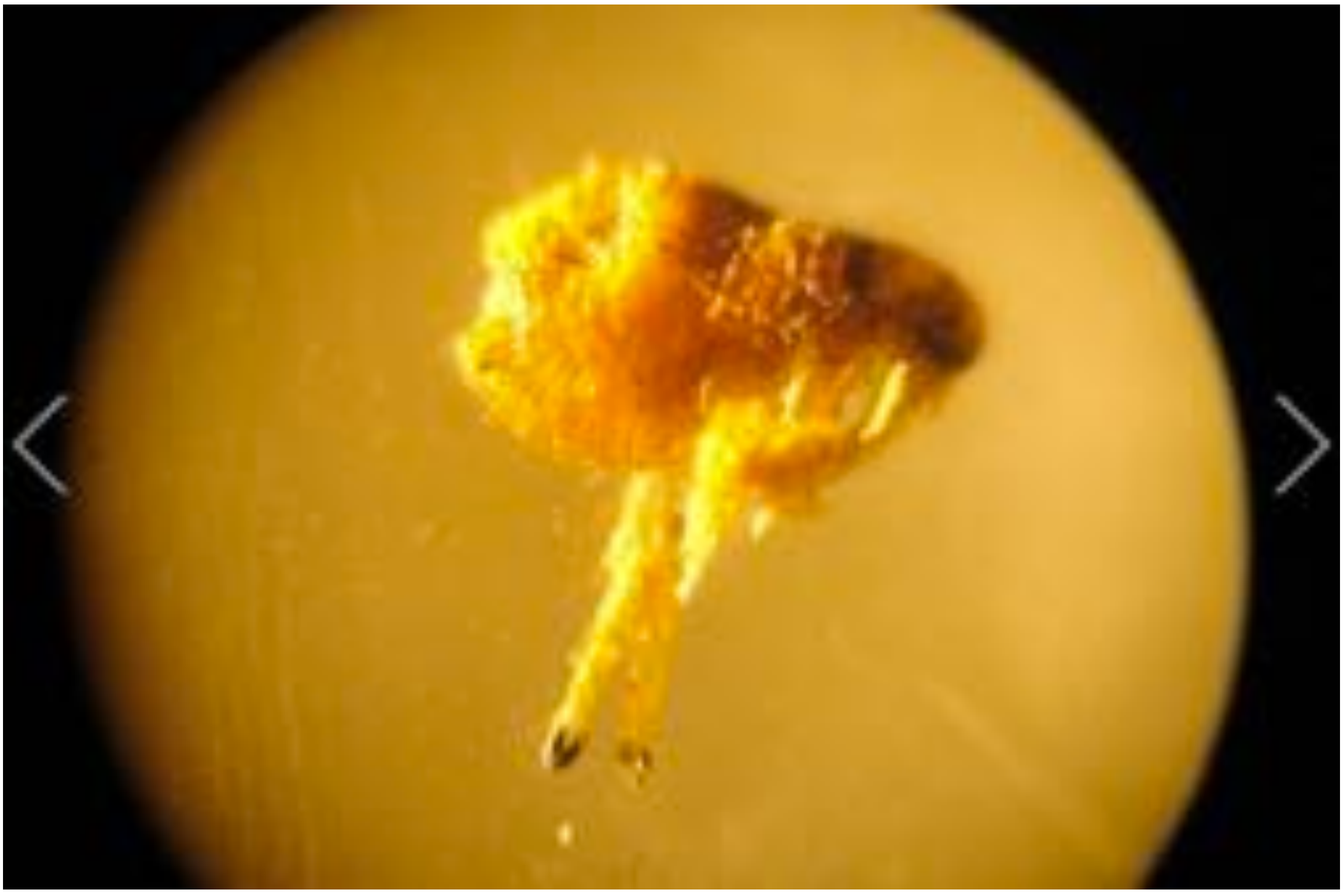
Одним из самых ярких образов в галерее лесковских «праведников» стал Левша («Сказ о тульском косом левше и о стальной блохе», 1881). Впоследствии критики отмечали здесь, с одной стороны, виртуозность воплощения лесковского «сказа», насыщенного игрой слов и оригинальными неологизмами (нередко с насмешливым, сатирическим подтекстом), с другой — многослойность повествования, присутствие двух точек зрения: открытой (принадлежащей простодушному персонажу) и скрытой, авторской, нередко противоположной[5] Об этом «коварстве» собственного стиля сам Н. С. Лесков писал:

> Ещё несколько лиц поддержали, что в моих рассказах действительно трудно различать между добром и злом, и что даже порою будто совсем не разберешь, кто вредит делу и кто ему помогает. Это относили к некоторому врожденному коварству моей натуры[21]

Как отмечал биограф Б. Я. Бухштаб, такое «коварство» проявилось прежде всего в описании действий атамана Платова, с точки зрения героя — почти героических, но автором скрыто высмеивающихся. «Левша» подвергся сокрушительной критике с обеих сторон. Либералы и «левые» обвинили Лескова в национализме, «правые» сочли чрезмерно мрачным изображение жизни русского народа. Н. С. Лесков ответил, что «принизить русский народ или польстить ему» никак не входило в его намерения[5]

При публикации в «Руси», а также в отдельном издании повесть сопровождалась предисловием:

> Я не могу сказать, где именно родилась первая заводка баснословия о стальной блохе, то есть завелась ли она в Туле, на Ижме или в Сестрорецке, но, очевидно, она пошла из одного из этих мест. Во всяком случае сказ о стальной блохе есть специально оружейничья легенда, и она выражает собою гордость русских мастеров ружейного дела. В ней изображается борьба наших мастеров с английскими мастерами, из которой наши вышли победоносно и англичан совершенно посрамили и унизили. Здесь же выясняется некоторая секретная причина военных неудач в Крыму. Я записал эту легенду в Сестрорецке по тамошнему сказу от старого оружейника, тульского выходца, переселившегося на Сестру-реку еще в царствование императора Александра Первого.



Начало современной эры нанотехнологий

There's Plenty of Room at the Bottom

An Invitation to Enter a New Field of Physics

 *by Richard P. Feynman*

This transcript of the classic talk that Richard Feynman gave on December 29th 1959 at the annual meeting of the American Physical Society at the California Institute of Technology (Caltech) was first published in Caltech Engineering and Science, Volume 23:5, February 1960, pp 22-36. It has been made available on the web at http://www.zyvex.com/nanotech/feynman.html with their kind permission. The scanned original is available.

The Wikipedia entry on Feynman's talk.

Information on the Feynman Prizes

Search YouTube for Richard Feynman

For an account of the talk and how people reacted to it, see chapter 4 of *Nano!* by Ed Regis, Little/Brown 1995. An excellent technical introduction to nanotechnology is *Nanosystems: molecular machinery, manufacturing, and computation* by K. Eric Drexler, Wiley 1992.

I imagine experimental physicists must often look with envy at men like Kamerlingh Onnes, who discovered a field like low temperature, which seems to be bottomless and in which one can go down and down. Such a man is then a leader and has some temporary monopoly in a scientific adventure. Percy Bridgman, in designing a way to obtain higher pressures, opened up another new field and was able to move into it and to lead us all along. The development of ever higher vacuum was a continuing development of the same kind.

I would like to describe a field, in which little has been done, but in which an enormous amount can be done in principle. This field is not quite the same as the others in that it will not tell us much of fundamental physics (in the sense of, "What are the strange particles?") but it is more like solid-state physics in the sense that it might tell us much of great interest about the strange phenomena that occur in complex situations. Furthermore, a point that is most important is that it would have an enormous number of technical applications.

What I want to talk about is the problem of manipulating and controlling things on a small scale.

As soon as I mention this, people tell me about miniaturization, and how far it has progressed today. They tell me about electric motors that are the size of the nail on your small finger. And there is a device on the market, they tell me, by which you can write the Lord's Prayer on the head of a pin. But that's nothing; that's the most primitive, halting step in the direction I intend to discuss. It is a staggeringly small world that is below. In the year 2000, when they look back at this age, they will wonder why it was not until the year 1960 that anybody began seriously to move in this direction.

Why cannot we write the entire 24 volumes of the Encyclopaedia Brittanica on the head of a pin?

Let's see what would be involved. The head of a pin is a sixteenth of an inch across. If you magnify it by 25,000 diameters, the area of the head of the pin is then equal to the area of all the pages of the Encyclopaedia Brittanica. Therefore, all it is necessary to do is to reduce in size all the writing in the Encyclopaedia by 25,000 times. Is that possible? The resolving power of the eye is about 1/120 of an inch – that is roughly the diameter of one of the little dots on the fine half-tone reproductions in the Encyclopaedia. This, when you demagnify it by 25,000 times, is still 80 angstroms in diameter – 32 atoms across, in an ordinary metal. In other words, one of those dots still would contain in its area 1,000 atoms. So, each dot can easily be adjusted in size as required by the photoengraving, and there is no question that there is enough room on the head of a pin to put all of the Encyclopaedia Brittanica.

Furthermore, it can be read if it is so written. Let's imagine that it is written in raised letters of metal; that is, where the black is in the Encyclopedia, we have raised letters of metal that are actually 1/25,000 of their ordinary size. How would we read it?

If we had something written in such a way, we could read it using techniques in common use today. (They will undoubtedly find a better way when we do actually have it written, but to make my point conservatively I shall just take techniques we know today.) We would press the metal into a plastic material and make a mold of it, then peel the plastic off very carefully, evaporate silica into the plastic to get a very thin film, then shadow it by evaporating gold at an angle against the silica so that all the little letters will appear clearly, dissolve the plastic away from the silica film, and then look through it with an electron microscope!

There is no question that if the thing were reduced by 25,000 times in the form of raised letters on the pin, it would be easy for us to read it today. Furthermore, there is no question that we would find it easy to make copies of the master; we would just need to press the same metal plate again into plastic and we would have another copy.

Los Angeles high school could send a pin to the Venice high school on which it says, "How's this?" They get the pin back, and in the dot of the 'i' it says, "Not so hot."

Perhaps this doesn't excite you to do it, and only economics will do so. Then I want to do something; but I can't do it at the present moment, because I haven't prepared the ground. It is my intention to offer a prize of $1,000 to the first guy who can take the information on the page of a book and put it on an area 1/25,000 smaller in linear scale in such manner that it can be read by an electron microscope.

And I want to offer another prize – if I can figure out how to phrase it so that I don't get into a mess of arguments about definitions – of another $1,000 to the first guy who makes an operating electric motor – a rotating electric motor which can be controlled from the outside and, not counting the lead-in wires, is only 1/64 inch cube.

I do not expect that such prizes will have to wait very long for claimants.

This page is part of the nanotechnology web site.

The Month at Caltech

The Alfred P. Sloan Laboratory of Mathematics and Physics, which houses Caltech's new 12,000,000-volt tandem accelerator, was officially dedicated this month. Here, with the accelerator — President DuBridge; Rear Admiral Rawson Bennett II, Chief of Naval Research; Dr. James R. Killian, chairman of the corporation of MIT; and Alfred P. Sloan, president of the Sloan Foundation, which financed the new building.

A crew of photographers invaded the campus last month to film a typical day at the Institute for a U. S. Information Agency movie on "Higher Education in the United States" which will be shown abroad. Here photographers move in on Hallet Smith, chairman of the division of humanities, lecturing on the Shakespearean theater.

The World's Smallest Motor

Ever since *Engineering and Science* ran his article on micro-miniaturization, "There's Plenty of Room at the Bottom," (February 1960) Richard P. Feynman, Caltech professor of physics, has been besieged by inventors of miniature motors. This, Feynman brought on himself, for he had ended his article by saying:

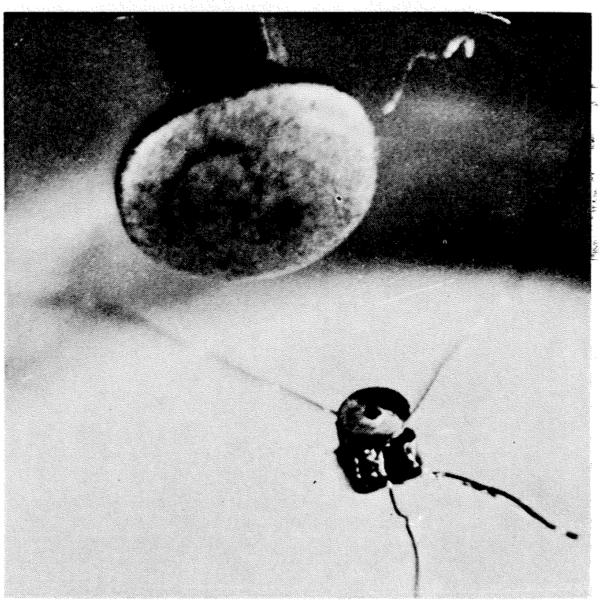
"It is my intention to offer a prize of $1,000 to the first guy . . . who makes a . . . rotating electric motor which can be controlled from the outside and, not counting the lead-in wires, is only 1/64th inch cubed."

So – after that it was a rare day when Feynman was not interrupted in his lab by someone eager to show him what usually turned out to be a *very* large small motor.

Last month, when William McLellan (Caltech '50) walked into Feynman's lab with *his* small motor, it looked like the same old story, because McLellan was carrying his invention in a big grocery carton.

O.K., said Feynman wearily, he'd look at the thing – but there was no money in it for anybody. It had been his *intention* to set up a prize, but he never got around to doing it.

That was all right with McLellan. It was the challenge that had set him to work on the problem anyway. Then he took a microscope out of the grocery carton and let Feynman look in it to see the motor he had built.



The McLellan micromotor, photographed under a microscope. The huge object above it is a pinhead.

It had taken McLellan 2½ months of lunch hours to make it, at Electro-Optical Systems in Pasadena, where he is a senior engineer. The motor was 1/64th of an inch cubed in size, or about as big as a speck in your eye. It weighed 250 micrograms, had 13 parts, was built with the aid of a microscope, a watchmaker's lathe, and a toothpick, and it could be controlled from the outside. As Feynman watched, McLellan set the rotor going.

William McLellan shows Students' Day visitors scale model of his motor 100 times larger than the original.

Feynman and McLellan spent the better part of the afternoon operating the motor. It was after he got home that night that Feynman's conscience began to bother him. After all, the motor was *exactly* what he had asked for.

"So," he says, "I sent the guy a check for a thousand bucks."

Elated as he is over the little motor, Feynman is now having worried thoughts about a *second* prize that he offered in his *E&S* article – another $1,000 "to the first guy who can take the information on the page of a book and put it in an area 1/25,000 smaller in linear scale in such a manner that it can be read by an electron microscope."

Daily, he expects to meet the man who has accomplished this spectacular feat. And, daily, the thought haunts him – because, in the meantime, Feynman has been married, bought a house and, what with one thing and another, hasn't *got* another spare $1,000.

This, then, is a public appeal by *Engineering and Science*, to all inventors who are now at work trying to write small and collect the Second Feynman Prize – TAKE YOUR TIME! WORK SLOWLY! RELAX!

Нанотехнология в фактах

Foresight Institute Feynman Prize in Nanotechnology

From Wikipedia, the free encyclopedia
(Redirected from Foresight Nanotech Institute Feynman Prize)

The **Feynman Prize in Nanotechnology** is an award given by the Foresight Institute every year for significant advancements in nanotechnology. It is named in honor of physicist Richard Feynman, whose 1959 talk *There's Plenty of Room at the Bottom* is considered to have inspired the beginning of the field of nanotechnology. The prize was established "to recognize researchers whose recent work has most advanced the field toward the achievement of Feynman's vision for nanotechnology: molecular manufacturing, the construction of atomically precise products through the use of molecular machine systems."[1]

The Foresight Institute also offers the Feynman Grand Prize, a $250,000 award to the first persons to create both a nanoscale robotic arm capable of precise positional control, and a nanoscale 8-bit adder, conforming to given specifications. The Grand Prize is intended to stimulate the field of molecular nanotechnology in the same way as similar historical prizes such as the Longitude prize, Orteig Prize, Kremer prize, Ansari X Prize, and two prizes that were offered by Richard Feynman himself as challenges during his 1959 *There's Plenty of Room at the Bottom* talk.[2]

The Foresight Institute offers a number of additional awards, which are the Distinguished Student Award for graduate and undergraduate students, the Prize in Communication for journalism and outreach efforts which promote public understanding of molecular nanotechnology, and Government Prize for government officials.[3]

Contents

Feynman prize winners

The prize was first given in 1993. Before 1997, one prize was given biennially. From 1997 on, two prizes were given each year in Theory and Experimental categories.

Single prize

Year	Laureate		Institution/Country	Rationale
1993		Charles Musgrave	California Institute of Technology	"for his work on modeling a hydrogen abstraction tool useful in nanotechnology"[4]
1995		Nadrian C. Seeman	New York University	"for developing ways to construct three-dimensional structures, including cubes and more complex polyhedra, from synthesized DNA molecules"[5]

Experimental category

Year	Laureate		Institution/Country	Rationale
1997		James K. Gimzewski	IBM Zurich Research Laboratory	"for work using scanning probe microscopes to manipulate molecules"[6]
		Reto Schlittler		
		Christian Joachim	CEMES-CNRS	
1998		M. Reza Ghadiri	Scripps Research Institute	"for groundbreaking work in constructing molecular structures through the use of self-organization, the same forces used to assemble the molecular machine systems found in nature"[7]
1999		Phaedon Avouris	IBM	"[for] the development of carbon nanotubes for potential computing device applications"[8]
2000		R. Stanley Williams	HP Labs	"for building a molecular switch, a major step toward their long-term goal of building entire memory chips that
		Philip Kuekes		

		James R. Heath	University of California at Los Angeles	are just a hundred nanometers wide"[9]
2001		Charles M. Lieber	Harvard University	"for his pioneering experimental work in molecular nanotechnology which included seminal contributions to the synthesis and characterization of the unique physical properties of carbon nanotubes and nanowires"[10]
2002		Chad Mirkin	Northwestern University	"for opening up new possibilities for the fabrication of molecular machine systems by selectively functionalizing nanoparticles and surfaces, particularly with DNA, enabling the self-assembly of new structures which move us closer to the goal of molecular manufacturing"[11]
2003		Carlo Montemagno	University of California at Los Angeles	"for his pioneering research into methods of integrating single molecule biological motors with nano-scale silicon devices, which opens up new possibilities for nanomachines"[12]
2004		Homme Hellinga	Duke University	"for his achievement in the engineering of atomically precise devices capable of precise manipulation of other molecular structures"[13]
2005		Christian Schafmeister	University of Pittsburgh	"for his work in developing a novel technology synthesizing macromolecules of intermediate sizes (between 1000 and 10,000 Daltons) with designed shapes and functions"[14]
2006		Erik Winfree	California Institute of Technology	"for their work demonstrating that DNA tiles can be designed to form crystalline nanotubes that exhibit a stiffness greater than the biological protein nanofilament actin, [and for having] established that algorithmic
		Paul W. K. Rothemund		

				self-assembly could work well enough to generate non-trivial non-periodic patterns"[15]
2007		J. Fraser Stoddart	University of California at Los Angeles	"[for having] pioneered the synthesis and assembly of unique active molecular machines for manufacturing into practical nanoscale devices"[16]
2008		James Tour	Rice University	"for the Synthesis of Nanocars... and other molecular machines [which] is providing critical insight in investigations of bottom-up molecular manufacturing"[17]
2009		Yoshiaki Sugimoto	Osaka University	"in recognition of their pioneering experimental demonstrations of mechanosynthesis, specifically the use of atomic resolution dynamic force microscopy — also known as non-contact atomic force microscopy (NC-AFM) — for vertical and lateral manipulation of single atoms on semiconductor surfaces"[18]
		Masayuki Abe		
		Oscar Custance	National Institute for Materials Science, Japan	
2010		Masakazu Aono	MANA Center, National Institute for Materials Science, Japan	"in recognition of his pioneering and continuing work, including research into the manipulation of atoms, the multiprobe STM and AFM, the atomic switch, and single-molecule-level chemical control including ultradense molecular data storage and molecular wiring; and his inspiration of an entire generation of researchers who have made their own ground-breaking contributions to nanotechnology"[1]

Theory category

Year	Laureate		Institution/Country	Rationale
		Charles Bauschlicher		
		Stephen		

1997		Barnard	NASA Ames, MRJ Team	"for work in computational nanotechnology"[6]
		Creon Levit		
		Glenn Deardorff		
		Al Globus		
		Jie Han		
		Richard Jaffe		
		Alessandra Ricca		
		Marzio Rosi		
		Deepak Srivastava		
		H. Thuemmel		
1998		Ralph C. Merkle	Zyvex, LLC	"for their computational modeling of molecular tools for atomically-precise chemical reactions"[7]
		Stephen Walch	ELORET NASA Ames	
1999		William A. Goddard III	California Institute of Technology	"for their work in modeling the operation of molecular machine designs"[8]
		Tahir Cagin		
		Yue Qi		
2000		Uzi Landman	Georgia Institute of Technology	"for his pioneering work in computational materials science for nanostructures"[9]
2001		Mark A. Ratner	Northwestern University	"[for being] a theorist whose work has made major contributions to the development and success of nanometer-scale electronic devices"[10]
2002		Don Brenner	North Carolina State University	"for fundamental advances in our ability to model molecular machine systems, and for the design and analysis of components likely to be important in future molecular manufacturing systems"[11]

2003		Marvin L. Cohen	University of California at Berkeley	"for their contributions to the understanding of the behavior of materials"[12]
		Steven G. Louie		
2004		David Baker	University of Washington	"for their development of RosettaDesign, a program that has a high success rate in designing stable protein structures with a specified backbone folding structure"[13]
		Brian Kuhlman	University of North Carolina	
2005		Christian Joachim	Center Nationale de la Recherche Scientifique, France	"for developing theoretical tools and establishing the principles for design of a wide variety of single molecular functional nanomachines"[14]
2006		Erik Winfree	California Institute of Technology	"for their 'Theory in Molecular Computation and Algorithmic Self-assembly' research... based on their demonstration of methods for universal computation with DNA, including using DNA tiles to simulate cellular automata"[15]
		Paul W. K. Rothemund		
2007		David A. Leigh	University of Edinburgh, UK	"[for] the design and synthesis of artificial molecular motors and machines from first principles and... the construction of molecular machine systems that function in the realm of Brownian motion"[16]
2008		George C. Schatz	Northwestern University	"first for sophisticated modeling and optimization of the dip pen nanolithography method of nanofabrication, and second, for his explanation of plasmon effects in metallic nanodots"[17]
				"in recognition of his pioneering theoretical work in mechanosynthesis in which he proposed specific molecular tools and analyzed them using ab initio quantum chemistry to validate their ability to build complex

2009		Robert A. Freitas Jr.	Institute for Molecular Manufacturing	molecular structures, [and] also his previous work in systems design of molecular machines, including replicating molecular manufacturing systems, which should eventually be able to make large atomically precise products economically, and the design of medical nanodevices, which should eventually revolutionize medicine"[18]
2010		Gustavo E. Scuseria	Rice University	"for his development of quantum mechanical methods and computational programs that make it possible to carry out accurate theoretical predictions of molecules and solids, and their application to the chemical and electronic properties of carbon nanostructures"[1]

See also

- Kavli Prize in Nanoscience

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6. ^ *a b* "1997 Feynman Prize in Nanotechnology Awarded to Teams at IBM Zurich and at NASA Ames" (http://www.foresight.org/about/1997Feynman.html) . Foresight Nanotech Institute.

Давайте напишем…

Next Up Previous Contents Index
Next: Molecular Engineering **Up:** Nanotechnology in Manufacturing **Previous:** Plenty Of Room

Writing With Atoms

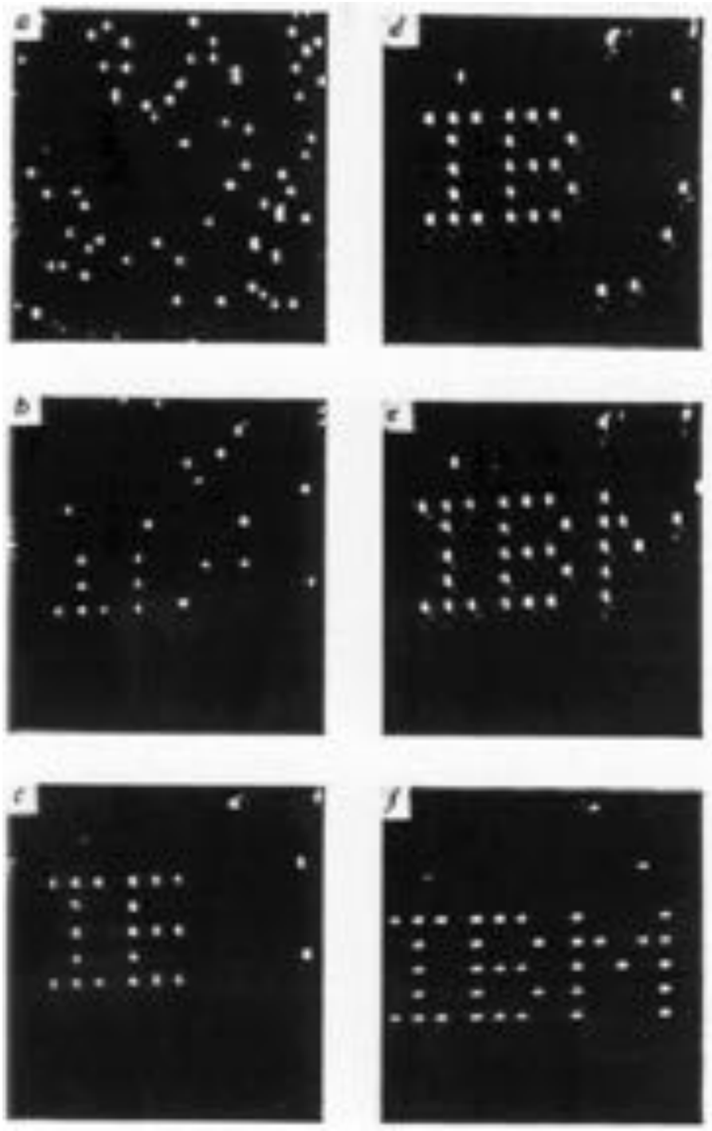
In 1981, Gerd Binnig and Heinrich Rohrer of the IBM Zürich Research Laboratory invented the Scanning Tunneling Microscope. This device, easily one of the most elegant and unanticipated inventions of the century, allowed imaging of individual atoms, and won Binnig and Rohrer the Nobel Prize in Physics for 1986.

In 1985, Binnig and Christoph Gerber of IBM Zurich, along with Calvin Quate of Stanford, invented the atomic force microscope. This allowed imaging nonconductive matter such as living cells to molecular (although not currently atomic) resolution.

Since then, every year has seen new inventions in the rapidly growing field of scanning probe microscopes. They're now imaging bits on magnetic surfaces, measuring temperature at microscopic sites, and monitoring the progress of chemical reactions.

Recently, IBM San Jose used a scanning tunneling microscope to, in Feynman's words, put the atom right where the chemist says.

Here's a picture of xenon atoms on a nickel crystal, lined up in a row by pushing them into place with an STM tip. Remember, those bumps are individual atoms, and they've been moved precisely into position, in a row, one half nanometre from each other.



Again, each dot in this picture is a single atom, and the letters are 5 nanometres tall.

Проблема 1 :

Сколько томов книг можно записать на квадратном сантиметре, используя плотность записи, достигнутую при написании слова “IBM” с помощью атомов ксенона?

Library of Congress

Coordinates: 38°53′19″N 77°00′17″W

From Wikipedia, the free encyclopedia

The **Library of Congress** is the research library of the United States Congress, *de facto* national library of the United States, and the oldest federal cultural institution in the United States. Located in three buildings in Washington, D.C., it is the largest library in the world by shelf space and number of books. The head of the Library is the Librarian of Congress, currently James H. Billington.

The Library of Congress was built for Congress in 1800, and was housed in the United States Capitol for most of the 19th century. After much of the original collection had been destroyed during the War of 1812, Thomas Jefferson sold 6,487 books, his entire personal collection, to the library in 1815.[2][3] After a period of decline during the mid-19th century the Library of Congress began to grow rapidly in both size and importance after the American Civil War, culminating in the construction of a separate library building and the transference of all copyright deposit holdings to the Library. During the rapid expansion of the 20th century the Library of Congress assumed a preeminent public role, becoming a "library of last resort" and expanding its mission for the benefit of scholars and the American people.

The Library's primary mission is researching inquiries made by members of Congress through the Congressional Research Service. Although it is open to the public, only Library employees, Members of Congress, Supreme Court justices and other high-ranking government officials may check out books. As the *de facto* national library, the Library of Congress promotes literacy and American

Library of Congress

Library of Congress reading room

Established	1800
Location	Washington, D.C.
Branches	N/A
Collection	
Size	22,194,656 cataloged books in the Library of Congress classification system 5,600 incunabula (books printed before 1500), monographs and serials, music, bound newspapers, pamphlets, technical reports, and other printed material, and 109,029,796 items in the nonclassified (special) collections 147,093,357 total Items[1]
Access and use	
Circulation	Library does not publicly circulate
Population served	541 members of the United States Congress, their staff, and members of the public

С чем работают физики...

Ток без напряжения

Ток без напряжения

PhysRevLett.70.2020 (1993)

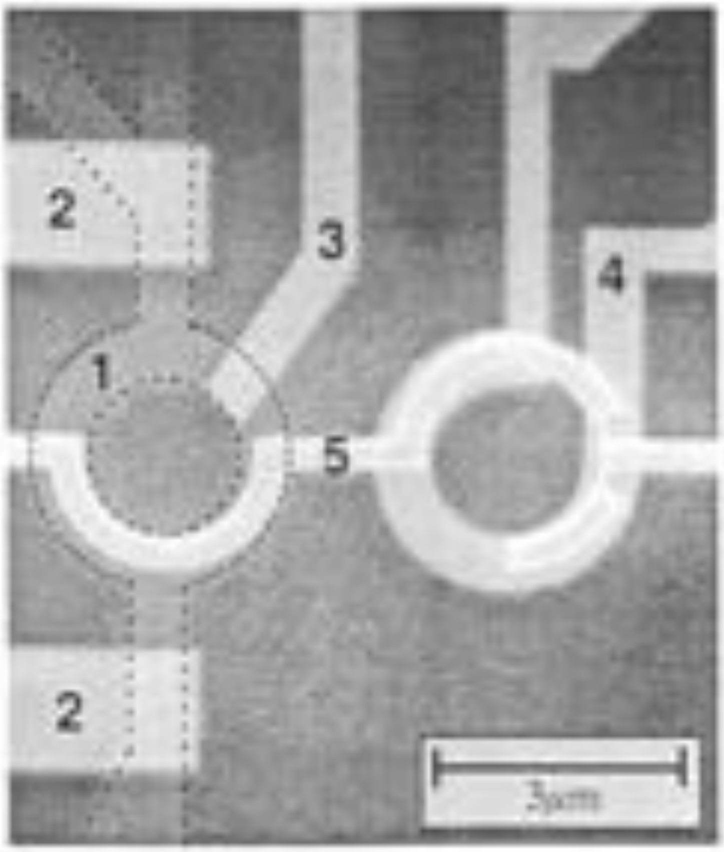


FIG. 1. Electron micrograph of the experimental device. On the left is the ring etched in GaAs 2DEG (labeled 1) (the dashed line has been added because of the poor contrast) with the two gates, (2) and (3). On the right is the calibration coil (4). On the top is the first level of the SQUID fabrication (5) with the two microbridge junctions on the right. The picture has been taken before the second level of the SQUID fabrication.

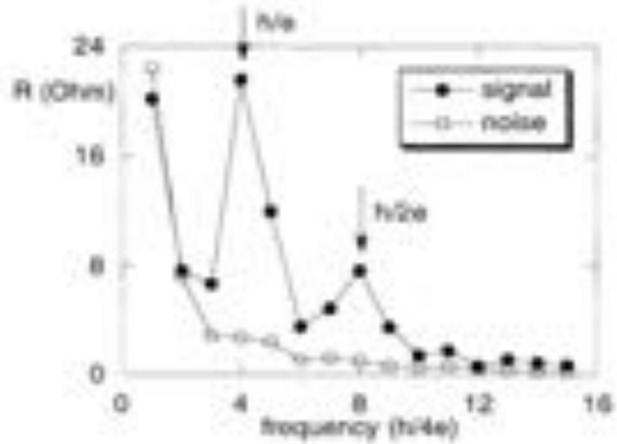


FIG. 2. Square root of spectrum power of the resistance fluctuations of the ring (mean resistance ≈ 1 kΩ). Open circles correspond to experimental noise, i.e., differences between measurements with ring open. Solid circles correspond to experimental signal, i.e., differences between measurements with ring closed and ring open. The two arrows indicate the position of period h/e and $h/2e$.

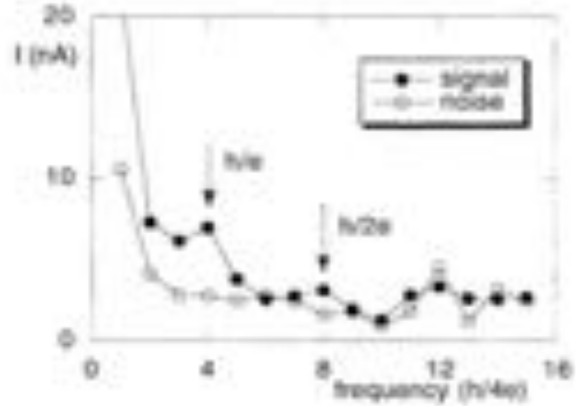


FIG. 3. Square root of spectrum power of magnetization of the ring. The values are converted into the equivalent current in the ring using the calibration coil. Open circles correspond to experimental noise, i.e., differences between measurements with ring open. Solid circles correspond to experimental signal, i.e., differences between measurements with ring closed and ring open. The two arrows indicate the position of period h/e and $h/2e$.

Квантование проводимости КТК

Квантование проводимости КТК

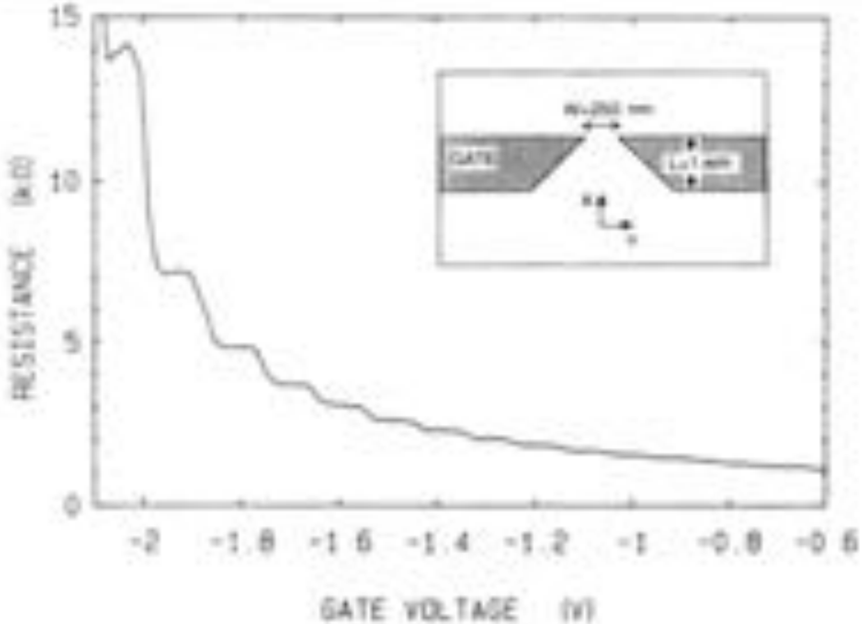


FIG. 1. Point-contact resistance as a function of gate voltage at 0.6 K. Inset: Point-contact layout.

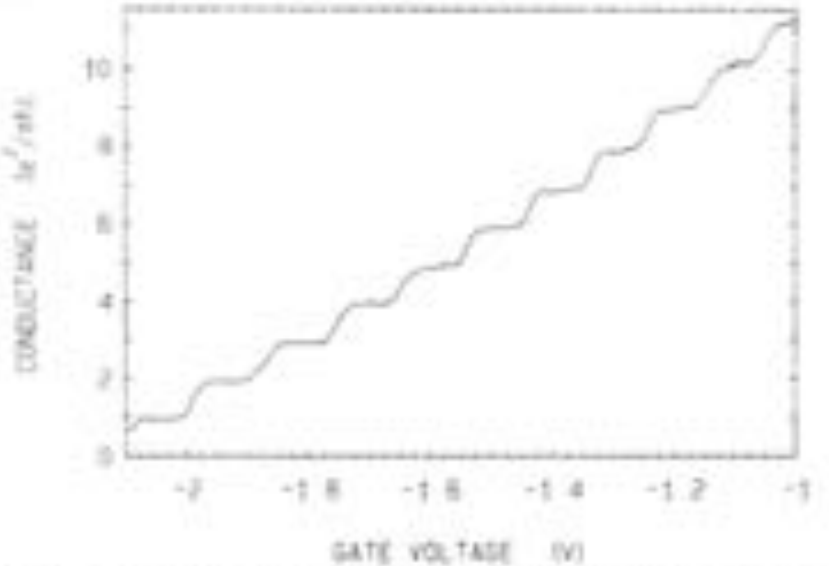


FIG. 2. Point-contact conductance as a function of gate voltage, obtained from the data of Fig. 1 after subtraction of the lead resistance. The conductance shows plateaus at multiples of $e^2/\pi\hbar$.

КТК в качестве детектора отдельных электронов

КТК в качестве детектора
отдельных электронов

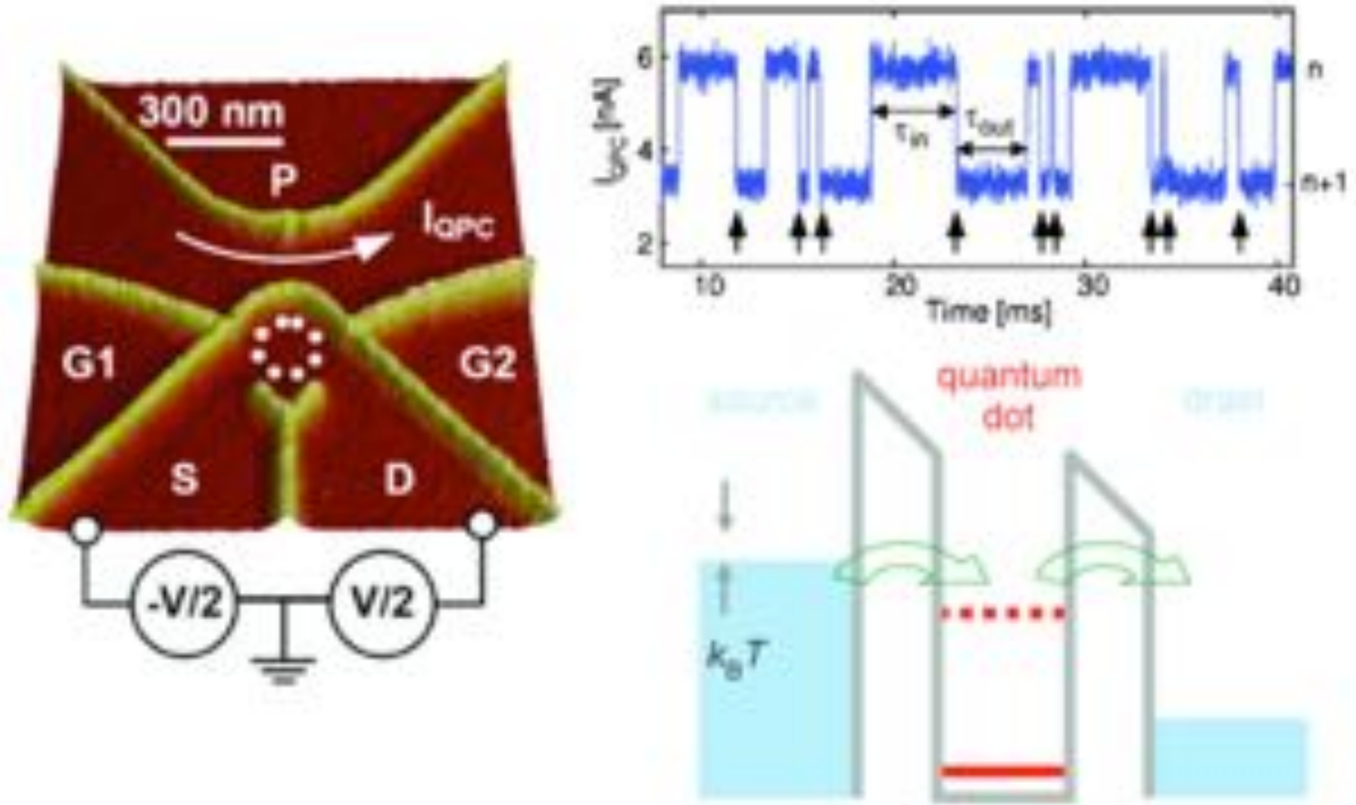


FIG. 1. (Color online) Left: SFM micrograph of the structure. Yellow lines indicate oxide lines written with the atomic force microscope in the surface of the AlGaAs heterostructure. The potential landscape of the electrons residing in the 2DEG 34 nm below the surface is very similar to the potential profile of the oxide lines. Upper right: typical time trace of a quantum point contact signal measured as electrons tunnel into and out of the quantum dot. Lower right: schematic diagram of the energy levels in the quantum dot and the corresponding chemical potentials in the source and drain leads. The applied bias is larger than the thermal smearing kT in the source and drain contacts (adapted from Ref. 6).

Молекула с "контактами"

Молекула с "контактами"

Figure 1

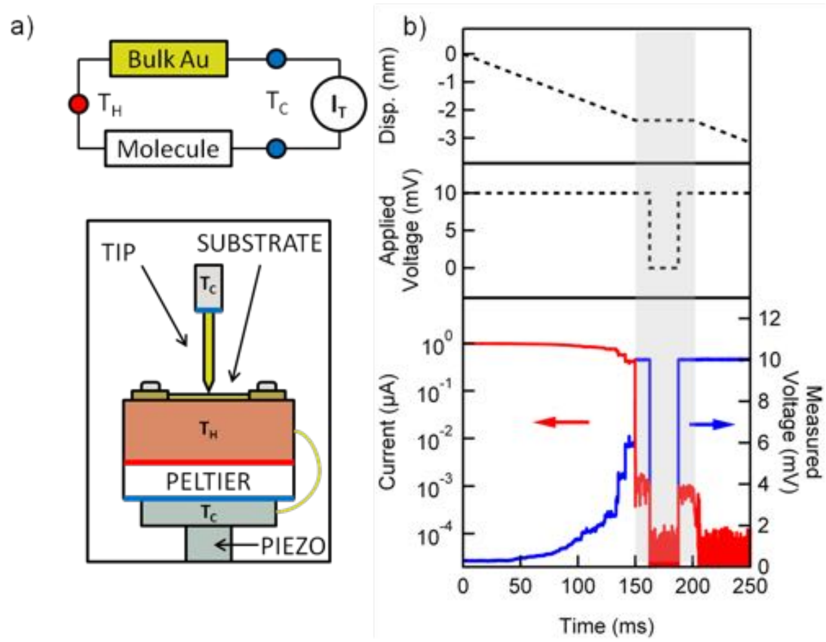


Figure 2

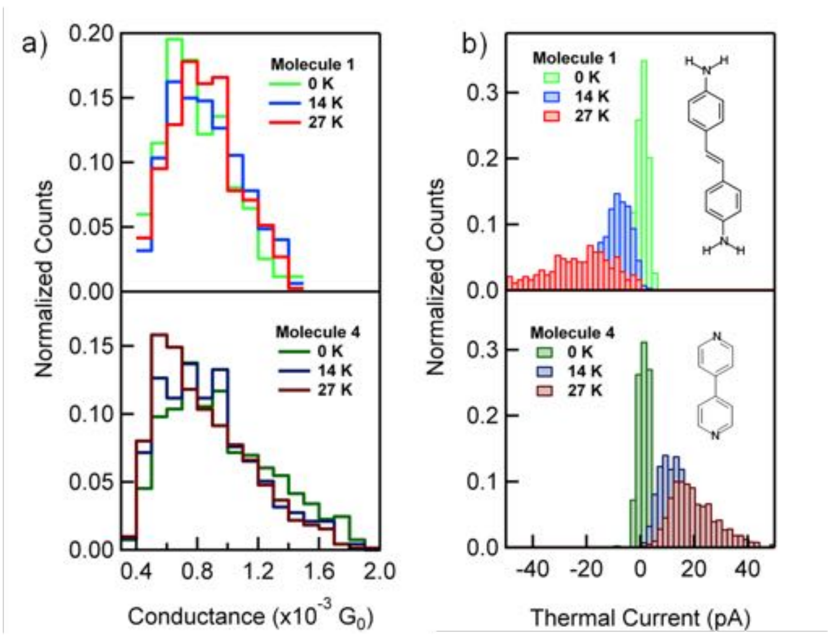


Figure 3

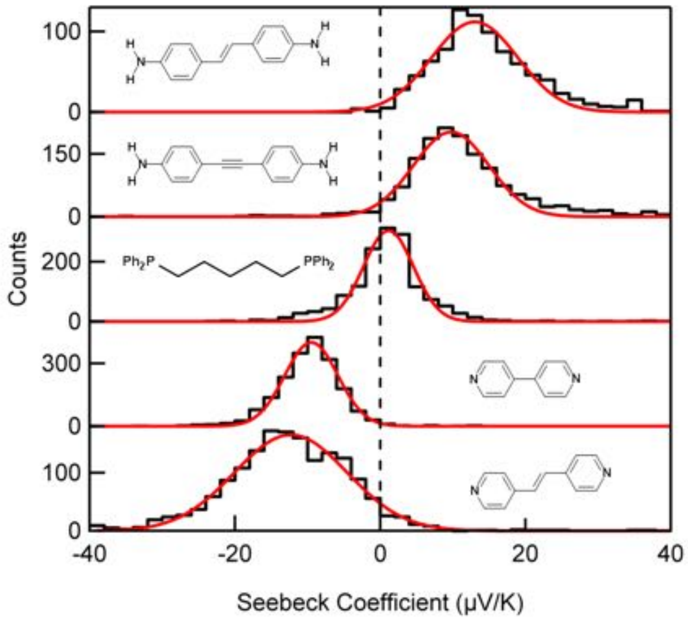
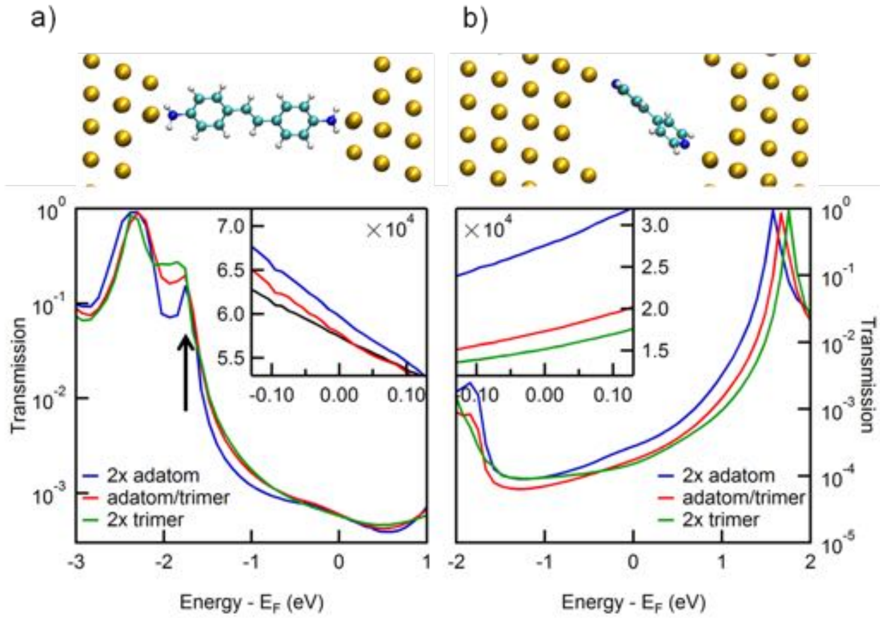


Figure 4



Проблема 2 :

Если к молекуле подвести электрические контакты и пропустить ток, то какое напряжение будет показывать вольтметр?

Как при этом будет распределен электрический потенциал в цепи?

Квантовая когерентная электроника

Квантовая когерентная
электроника

NATURE PHYSICS DOI: 10.1038/NPHYS1429 LETTERS

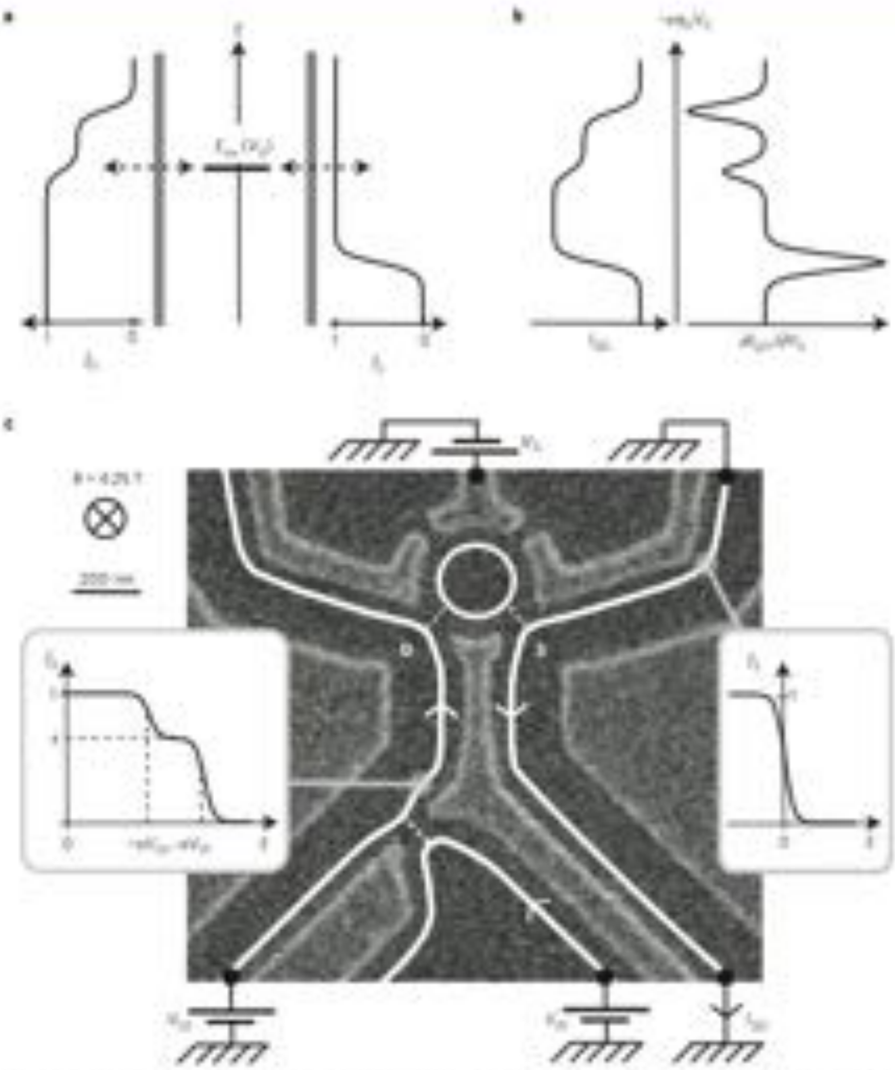


Figure 1 | Experimental implementation of non-equilibrium edge-channel spectroscopy. a, Schematic description of the energy distributions' $f_{L,R}(E)$ spectroscopy with a single active electronic level of tunable energy $E_{lev}(V_L)$ in the quantum dot. **b,** The current I_{QD} ($\partial I_{QD}/\partial V_L$) is proportional to $f_L(E)-f_R(E)$ ($\partial(f_L(E)-f_R(E))/\partial E$) ignoring variations in tunnel rates and tunnelling density of states. **c,** Electron-beam micrograph of the sample. Surface metal gates appear brighter. Electronic excitations propagate anticlockwise along two edge channels of the quantum Hall regime. The outer edge channel (solid white lines) is partly transmitted (dashed lines) across the QPC and the quantum dot. The inner edge channel (not shown) is always reflected. The QPC is used to drive out-of-equilibrium the drain outer edge channel. Gates partly covered by the insets are grounded and do not influence the electron paths. Left inset: Non-interacting electrons prediction for $f_L(E)$ in the outer edge channel at the output of the QPC. Right inset: Equilibrium Fermi function f_R emitted by a cold ground.

Наномотор

Наномотор

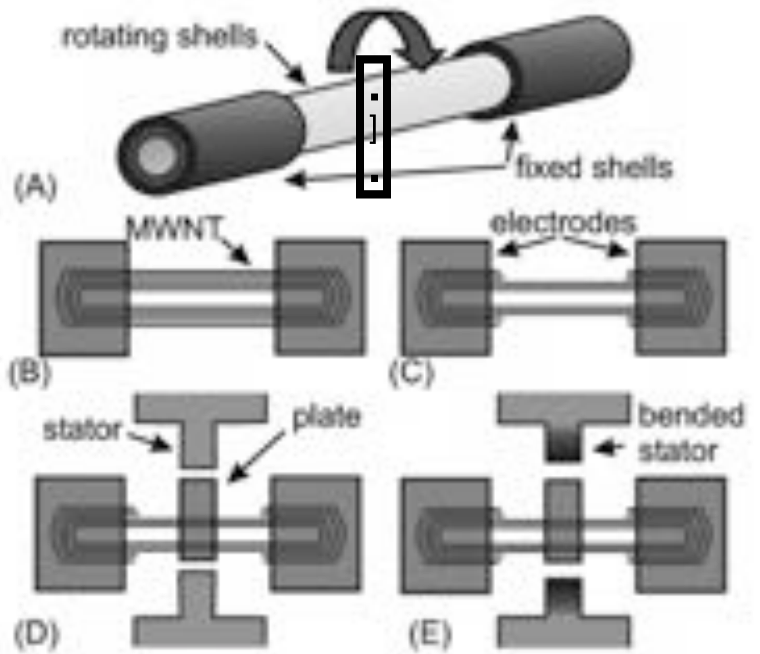


Figure 1. (A) Inner shells turn inside fixed outer shells. (B) The MWNT is contacted to two conducting anchor pads made of 10 nm Cr and 60 nm Au and separated by around 1 μm. (C) Several shells are removed between the contacts to gain access to a selected inner shell. (D) A plate and two stator electrodes are fabricated. The structures consist of 10 nm Cr and 25 nm Au. (E) Etching step with BHF.

dispersed onto a 1000 nm oxidized Si wafer from a dispersion in dichloroethane. Thick MWNTs of diameter between 15 and 25 nm are selected with AFM because they are mechanically more robust. The nanotubes are then connected with two electrodes using electron beam lithography (Figure 1B). These electrodes will be used both as conducting electrodes and as anchor pads that hold the nanotube bearing.

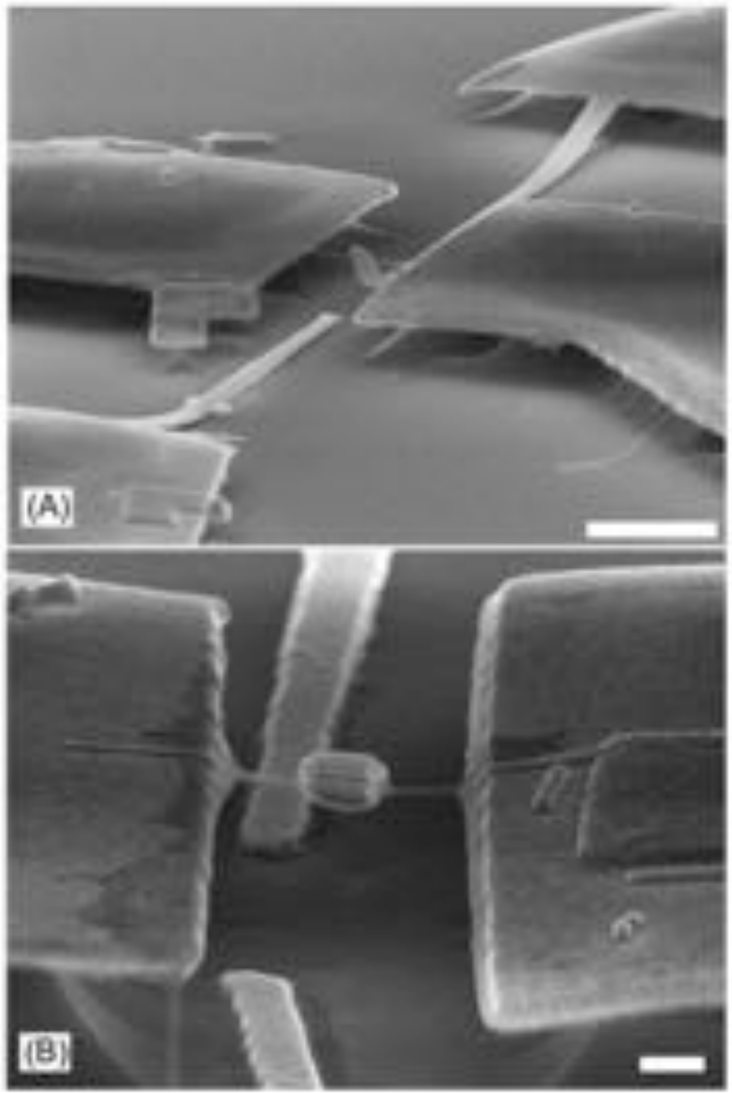


Figure 2. SEM images of two samples at the end of the fabrication process. (A) Scale bar, 1 μm. (b) Scale bar, 200 nm.

Графен – моно-атомная плоскость

Графен – моно-атомная плоскость

THE RISE OF GRAPHENE

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Manchester Centre for Mesoscience and Nanotechnology, University of Manchester, Oxford Road M13 9PL, United Kingdom

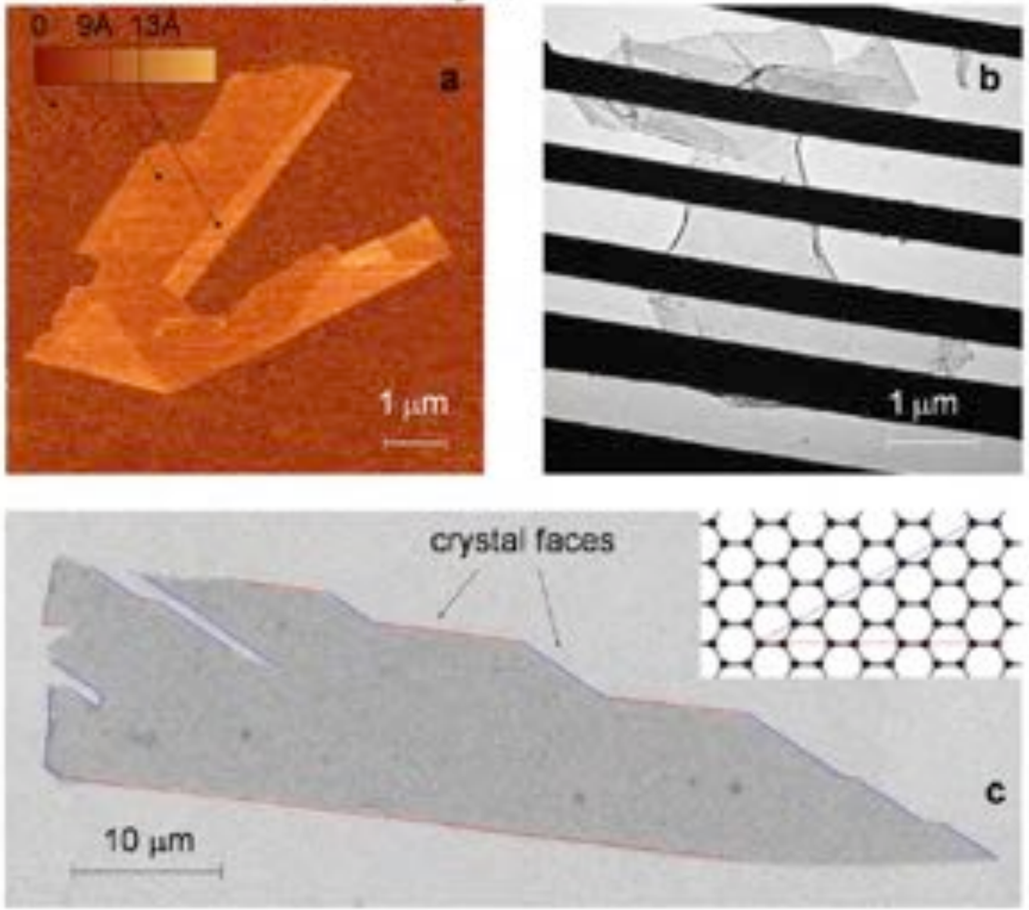

Figure 2. **One-atom-thick single crystals: the thinnest material you will ever see. a,** Graphene visualized by atomic-force microscopy (adapted from ref. 8). The folded region exhibiting a relative height of ≈4Å clearly indicates that it is a single layer. **b,** A graphene sheet freely suspended on 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.

В следующей лекции :

“Все про графен”