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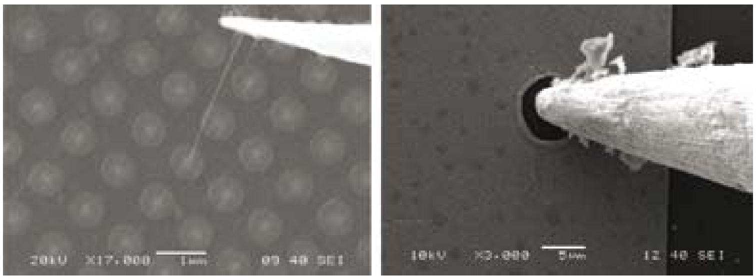
seit 1. September 2006 Professor für Organisch/molekulare Elektronik am Institut für Festkörperphysik

Since atoms are a fraction of a nanometer in diameter, measurements at the nanometer scale will always be important for understanding the properties of materials. This is also the scale of the smallest devices. The smallest transistors, motors, pumps, lasers, and detectors are all a few nanometers in size. Peter Hadley is setting up a laboratory to be able to make electrical measurements on this scale. An electrical probe station inside a scanning electron microscope (SEM) will be used to perform multi-tip electrical measurements where all of the tips will be within about one micron of each other. In the probe station, it will be possible to move up to six tips independently with nanometer resolution. The tips will be programmed to automatically make a series of voltage measurements, spaced about one nanometer apart, along a line or in a square grid. This way the electrostatic potential as a function of position throughout the nanostructure will be mapped. Being able to make electrical measurements on the scale of nanometers will be useful for testing theories where voltages are expected to drop over nanometer scale distances or current densities are expected to be nonuniform in space on this scale. For instance, this measurement system would be useful for looking at polymer films which often consist of crystalline regions imbedded in an amorphous matrix. The tips can also be used for cutting, drilling, welding or manipulating small objects like carbon nanotubes. Techniques for machining at the nanoscale will be refined so that an entire nano-workshop will be available to make prototype structures.

It is expected that the use of nanomaterials will bring improvements in electronics, memories, displays, solar cells, light sources, catalysts, and medicine. The nanostructures that are being investigated for these applications include carbon nanotubes, semiconducting nanowires, fullerenes, quantum dots, and organic fibers produced



Left: A multiwalled carbon nanotube was attached to a tungsten tip. The carbon nanotube was used as a small voltage probe. The sample that was being measured consists of an array of semiconducting nanowires. Right: A spark was used to ablate an aluminum film using a probe tip. Both experiments were performed in Hadley's laboratory while he was still in Delft.

by supermolecular chemistry. Usually some form of self-assembly is required to incorporate the nanostructures into devices. The self-assembly of nanostructures is an active field of research that will become a focus of our work. Often we are inspired by the self-assembly that occurs in biological systems. For instance, the flagella that propel single celled bacteria are driven by motors 50 nm in diameter. These motors have a chemical composition such that they insert themselves into a cell wall. We intend to chemically modify the nanostructures we are working with so that they will exhibit similar self-assembly properties. This is interdisciplinary work that will require collaborations between chemists and physicists. The Institute of Solid State Physics provides a stimulating environment to initiate this research since it has a long history of analyzing materials on the atomic scale as well as collaborating with chemists and industrial partners.

Peter Hadley was born in Boston in 1960. He received a B.S. degree in Applied and Engineering Physics from Cornell University in 1982 and a PhD in Applied Physics from Stanford University in 1989. From 1989 to 2006 he was a postdoc, then assistant professor and then associate professor at the Delft University of Technology in the Netherlands. In September 2006 he became a professor at the Institute of Solid State Physics at the TU Graz.

Da der Durchmesser von Atomen Bruchteile eines Nanometers misst, werden Messungen auf der Nanometerskala für das Verständnis von Materialeigenschaften immer wichtig sein. Dies ist auch die Skala der kleinsten Bauteile. Die kleinsten Transistoren, Motoren, Pumpen, Laser und Detektoren sind einige wenige Nanometer groß. Peter Hadley baut gerade ein Labor auf, das elektrische Messungen auf dieser Größenskala ermöglichen soll. Innerhalb eines Rasterelektronenmikroskops wird sich ein Spitzenmessplatz befinden, mit dem man elektrische Messungen durchführen und man mehrere Spitzen mit Abständen unter einem Mikrometer auf einer Probe platzieren kann. Die Spitzen können so programmiert werden, dass die Spitzen entlang einer Linie oder einer Fläche nanometerweise abgerastert und jeweils eine Spannungsmessung durchgeführt wird. Auf diesem Wege kann das elektrostatische Potential einer Nanostruktur ortsaufgelöst bestimmt werden. Die Spitzen können außerdem zum Schneiden, Bohren, Schweißen oder Manipulieren von kleinen Objekten wie zum Beispiel Carbon Nanotubes (Kohlenstoff-Nanoröhren) verwendet werden. Techniken zum Bearbeiten auf der Nanoskala sollen verbessert werden, so dass eine vollständige Nanowerkstatt zum Herstellen von Prototypen zur Verfühung stehen wird.

Peter Hadley wurde 1960 in Boston geboren. Er empfing einen B.S. Grad der technischen Physik von der Cornell Universität 1982 und in ein PhD der technischen Physik von der Stanford Universität 1989. Von 1989 bis 2006 war er ein postdoc, dann Assistant Professor und dann Associate Professor an der TU Delft Universität in den Niederlanden. Im September 2006 wurde er als Professor an das Institut von Festkörperphysik an der TU Graz berufen.

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