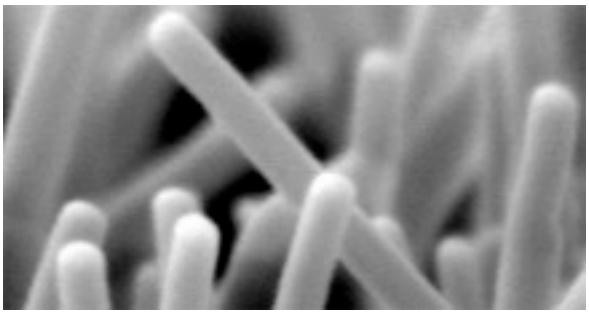
Carbon Nanotubes and Hockey Sticks

Carbon has different forms, the best known of which are graphite, a soft substance made of layers of carbon, and diamond, an extremely hard substance made of carbon atoms joined in a rigid crystal. In 1985, scientists discovered the buckminsterfullerene molecule, also known as a buckyball or fullerene. This previously unknown form of carbon is an arrangement of 60 carbon atoms in a spherical structure. The discoverers' of the fullerene thought the geometry of the spherical arrangement of atoms resembled a geodesic dome (think of the Spaceship Earth at Disney's Epcot) and named the molecule after the dome's inventor, R. Buckminster Fuller. Others have compared the fullerene to a soccer ball.

Following the discovery of the fullerene, researchers worldwide were inspired to look for other forms of carbon. In 1991, Japanese scientist Sumio Iijima discovered the carbon nanotube.



[A scanning electron microscope image of nanowires. Each rod in the image is about 50 nanometers wide.]

Carbon nanotubes are ridiculously strong (much stronger than steel), light, and flexible. NASA is very interested in using them to create lighter and stronger spacecraft. Nanotubes have already been put to work in aircraft, lightweight bicycle frames, super-strong hockey sticks, and other sporting equipment. They may also be used to make car bodies stronger and lighter, contributing to fuel economy.

But even more interesting than the strength of carbon nanotubes is their electrical conductivity. They may be the perfect material for making tiny electrical circuits, since electricity passes through them with very little resistance. In 2002, researchers succeeded in making nanotube transistors. At

IBM, researchers used a single carbon nanotube to create a working computer circuit

What does this mean for the future of computing? Perhaps you've heard of Moore's Law. In 1965, Intel co-founder Gordon Moore predicted that computer processing power, or the number of transistors on an integrated chip, would double every 18 months. This prediction became known as Moore's Law, and so far, it's held true. In 1965, a single chip held 30 transistors. Six years later, Intel introduced its first chip, which held 2,000 transistors. Today's chips have 400 million transistors.

As chipmakers pack more chips into less space, we get faster computing and greater data storage—at a lower price. In 1968, you paid about a dollar for a single transistor; today you pay a dollar for 4 million transistors.

But there's a limit to how many transistors can be packed onto a silicon chip. Researchers are looking to carbon nanotubes to come in when the features on silicon chips just can't be made any smaller.