Carbon nanotubes are the newest trend in electronics research. They are the special interest of Electrical & Computer Engineering’s newest assistant professor, Ant Ural. Ural joined the faculty in November 2003 and will do research into nanomaterials integration with ECE’s Device and Physical Electronics laboratory.

Ural began exploring the use of nanotubes while doing postdoctoral work at Stanford University. His specific interest is in developing organized nanotube architectures for molecular-level electronics.

Ural explains that electronic chips and integrated circuits have constantly been shrinking for years, but as is well known, they are reaching the physical limitations of size and cost. A new research thrust is investigating how electronics can be built from the bottom up, using nanomaterials with suitable electronic characteristics.

Carbon nanotubes have demonstrated excellent electronic characteristics in experiments. However, the way nanotubes are created does not make them automatically suitable for electronics. Nanotubes are typically grown in a bundle. The resulting tubes are not identical, but can have different diameters and structure. This matters because the way nanotubes conduct electricity depends on their structure. To be useful in electronic circuitry, nanotubes need to be uniform and directional.

Ural’s research is on the directional growth of single-walled carbon nanotubes built on a silicon substrate. He creates the nanotubes by flowing gases such as methane or ethylene at high temperatures – 900 degrees C – over the substrate which is covered with nucleation sites, made from transition metals, which are iron, nickel, or similar materials. The nanotubes grow from the nucleation sites, which serve as anchors for the tubes.

Directional growth is obtained by adding an electric field during the growth phase. The tubes can be persuaded to grow in one direction, following and aligning with the electric field. Nanotubes are sensitive to mechanical deformation, Ural says. Mechanical deformations affect their electronic characteristics. Ural believes the use of nanotubes in electronics will likely complement silicon technology in roles such as sensors.

Martha Dobson