



Carbon Nanopearls

Making New Carbon Materials for the Electronics of the Future



Dayton, OH (Wright-Patterson Air Force Research Lab)—Engineers have created new materials called carbon nanopearls—carbon structures that look like strings of pearls when viewed through a powerful microscope. The nanopearls are made in a hot tube using flowing gases and a catalyst. Future uses could include electronic applications such as TV monitors.

"Nanopearls are actually much, much smaller than a human hair." **Shanee Pacley, materials engineer**

Framework

Middle School

Standards

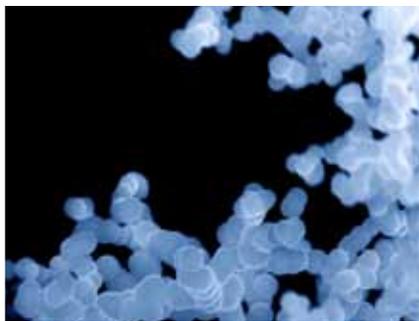
- NSES - B.i.1 ➤ A substance has characteristic properties.
- STL - 3.E ➤ A product developed for one setting may be applied to another.
- STL - 10.G ➤ Invention and innovation play a role.
- STL - 19.1 ➤ Chemical technologies modify chemical substances.

Content Illustrated

- Different materials made of carbon (diamonds, graphite) have different internal structures and characteristic properties.



Content



Physical Science

- Carbon nanopearls are made of pure carbon. The way the atoms are arranged in different pure-carbon substances results in the materials having very different properties.
- A diamond is made of carbon atoms arranged in a rigid network. The carbon atoms in graphite are arranged in layers. A graphite pencil works by shedding layers of carbon as you slide it across the paper to write.
- Carbon nanopearls are excellent conductors of electricity.

Technology

- To make nanopearls, a glass tube is filled with nitrogen gas and heated. Acetylene gas (C_2H_2 , a source of carbon) is also put into the tube. Nickel on the lining of the tube is used as a catalyst. When nickel atoms leave their place on the lining of the tube, carbon atoms from the acetylene gas take their place.
- Nanopearls can be seen using a microscope that uses electrons.

Engineering

- Engineers are exploring applications that take advantage of the mechanical and electrical properties of nanopearls. These may include field emission display (FED) television screens.

Math

- A nanometer is $1/1,000,000,000$ meters.
- One nanometer is one billionth of a meter.

Guiding Questions

To think about as you watch:

- *Carbon Nanopearls* could be viewed together with *It's a Small World*. What is nanotechnology?
- What are naturally occurring forms of carbon? How do their microstructures differ? How do the materials' properties differ?

Suggested Activities

- Research how FED (field emission display) works.

- *Carbon Nanopearls* can be found online at www.ndep.us/ Carbon-Nanopearls. Visit www.ndep.us/LabTV for a list of process skills modeled in webisodes.

Keywords

acetylene, atoms, carbon, carbon nanotubes, field emission display, graphite, materials engineering, nanometer, nanopearls, nanotubes, nickel catalyst, nitrogen