Sugar-Coated Nanotubes Deliver High-Dose Radiotherapy

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Starting with simple carbon nanotubes, a team of researchers from the United Kingdom and Spain has developed a sugar-coated nanocapsule that can deliver large doses of radioactivity to tumors. The researchers envision developing a series of nanoscale delivery devices that can target specific organs in the body for radiation therapy or imaging by tinkering with the sugar coating on the nanocapsule.

The research team was led by Benjamin Davis of Oxford University, Kostas Kostarelos of the University of London, and , and Gerard Tobias of the Institut de Cičncia de Materials de Barcelona. The investigators reported the results of their work in the journal *Nature Materials.*

To create their loaded nanotubes, the investigators prepare a mixture of carbon nanotubes and sodium iodide made from radioactive iodine-125 inside a silica ampoule and heated it to 900° C for four hours. When heated to this temperature, sodium iodide and other metal salts form nanocrystals inside the nanotubes. As the nanotubes cool, their ends self-seal, trapping the radioactive nanocrystals safely inside the carbon containers. After washing the sealed tubes to remove any salts that aren't encased, the researchers then perform a mild chemical reaction that leaves the end caps unaltered while adding chemical groups to which sugar molecules can attach. In a final step, the scientists add one of many types of sugar molecules to the nanotube surface. In this study, they used a simple sugar known as N-acetyl glucosamine. The researchers note that this synthetic scheme can be used to add other radioactive metal salts to nanotubes and to add other sugar molecules to the surface of the

nanotubes.

Numerous tests showed that radioactive payload remained trapped in the sealed nanotubes under a variety of physiological conditions. When injected into tail vein of mice, the researchers were able to image the nanotubes as they accumulated in the lungs using a common imaging technology known as single photon emission computed tomography, or SPECT.

When injected into the body, free sodium iodide normally concentrates in the thyroid gland, not the lungs. The carbon nanotubes did not accumulate in liver, spleen, and kidneys or other organs that usually accumulate injected nanoparticles. The researchers hypothesize that N-acetyl glucosamine targets the nanotubes to the lung by binding to a lung-specific protein known to bind tightly to this sugar.

This work is detailed in a paper titled, “Filled and glycosylated carbon nanotubes for in vivo radioemitter localization and imaging.” An abstract of this paper is available at the journal’s Web site.

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