Flexible Nanotubes that Permit Safer Drug Delivery

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Technology description

Performs Tissue-Targeted Drug Delivery Without Health Risks From Carbon Nanotubes

This nano-enabled drug delivery system (DDS) uses nanotubes composed of lignin, a major component of plant cell walls, potentially eliminating the risks associated with carbon-based nanotechnology DDS. One of the most promising medical applications of nanotechnology to date is the use of nanotechnology DDS for cancer treatment. The nanotechnology DDS market is projected to exceed $136 billion by 2021. Since anti-cancer drugs are often toxic to healthy tissue and result in side effects such as hair loss, digestive system problems, lethargy, and ulcers, scientists have experimented with delivering the cancer-fighting medications inside carbon nanotubes, so that the protective carbon shell of the nanotubes may provide some shielding to the surrounding healthy tissue. Unfortunately, research has shown that carbon nanotubes, which have thin, needle-like shapes, behave much like asbestos fibers when introduced into living tissue. Their large surface-area-to-volume ratio makes them highly reactive, increasing the risk of free-radical production and inflammation. Carbon nanotube DDS not only damage proteins, membranes, and DNA, but might even promote cancer formation, thus counteracting their very purpose when delivering anti-cancer drugs.
Researchers at the University of Florida have created softer, more flexible lignin nanotubes that should greatly reduce the negative health effects associated with carbon nanotube-enabled DDS. Lignin is a plant cell-wall polymer that generates as a waste product from paper mills and bio refineries, meaning that the raw starting material is cheap and abundant. An additional advantage is that these lignin nanotubes are based on the buckminsterfullerene structure, which makes them naturally fluorescent and easier to functionalize for specific applications. These novel lignin nanotubes provide a cost-efficient, safer alternative to the carbon nanotubes.

Technology

The chemical inertness and sharp edges of carbon nanotubes seem to increase the prevalence of dangerous free radicals, which have negative effects on patients’ health. University of Florida researchers have developed nanotubes that are softer, more flexible, and derived from a naturally occurring plant polymer, making them safer than carbon nanotubes for health-related applications. The researchers synthesized these lignin-based structures in a template of commercially available alumina

membranes and added layers of a dehydrogenation polymer onto a lignin base layer via a peroxidase-catalyzed reaction to modify structural and optical properties.

Application area

Lignin-based nanotube drug-delivery system that can deliver medications to specific sites within the body (e.g. tumors) without damaging healthy tissue

Advantages

Features superior biocompatibility and biodegradability, increasing safety compared to traditional carbon nanotubes in health-related applications
Uses inexpensive raw materials, lowering manufacturing costs
Supports modification of structure length, wall thickness, and optical properties, maximizing utility
Uses a buckminsterfullerene structure, making the nanotubes naturally fluorescent and more easy to functionalize to enhance versatility for numerous nanotechnology applications

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