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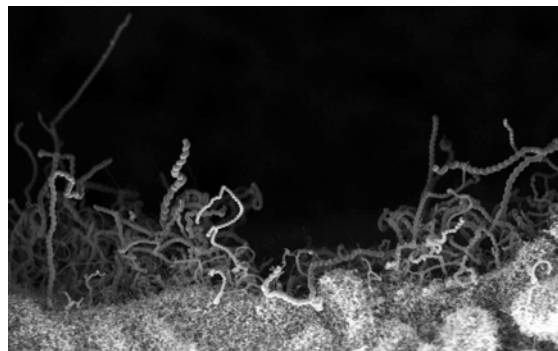
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Biomedical Engineering

Bone-Growing Nanomaterial Could Improve Orthopaedic Implants

Bone-forming cells grow faster and produce more calcium on anodized titanium covered in carbon nanotubes compared with plain anodized titanium and the non-anodized version currently used in orthopaedic implants, new Brown University research shows. The work, published in *Nanotechnology*, uncovers a new material that can be used to make more successful implants. The research also shows tantalizing promise for an all-new device: a “smart” implant that can sense and report on bone growth.

PROVIDENCE, R.I. [Brown University] — For orthopaedic implants to be successful, bone must meld to the metal that these artificial hips, knees and shoulders are made of. A team of Brown University engineers, led by Thomas Webster, has discovered a new material that could significantly increase this success rate.



“Possibly a terrific new material”

A titanium surface covered by carbon nanotubes could lead to faster, better growth of implanted bone-growing cells and an improved success rate for orthopaedic surgery. The carbon nanotubes could even self-report, keeping doctors informed about the healing process.

Image: Sirinrath Sirivisoot/Brown University

The secret: carbon nanotubes on anodized titanium. The team took titanium – the most popular implant material around –

and chemically treated it and applied an electrical current to it. This process, called anodization, creates a pitted coating in the surface of the titanium. Webster and his team packed those pits with a cobalt catalyst and then ran the samples through a chemical process that involved heating them to a scorching 700° C. That caused carbon nanotubes to sprout from each pit.

Researchers then placed human osteoblasts, or bone-forming cells, onto the nanotube-covered samples as well as onto samples of plain and anodized titanium. The samples were placed in an incubator. After three weeks, the team found that the bone cells grew twice as fast on the titanium covered in nanotubes. Cells interacting with the nanotubes also made significantly more calcium – the essential ingredient for healthy bones.

Results are published in *Nanotechnology*.

“What we found is possibly a terrific new material for joint replacement and other implants,” said Webster, associate professor of engineering at Brown. “Right now, bone doesn’t always properly meld to implants. Osteoblasts don’t grow or grow fast enough. Adding carbon nanotubes to anodized titanium appears to encourage that cell growth and function.”

Webster’s long-term vision for the new material is ambitious. With it, Webster hopes to create a new class of implants – ones that can sense bone growth then send that information to an external device. Doctors could monitor the output and determine whether to inject growth hormones or otherwise intervene to avoid additional surgery. Right now, implant patients must get an X-ray or undergo a bone scan to monitor bone growth.

Webster thinks these “biosensing” implants could even be designed to detect infection and be specially

coated to release antibiotics or other drugs into the body.

Webster said the biosensing concept would work because when cells make calcium, an electrical current is created. That current can be conducted through carbon nanotubes and transmitted via radio frequency to a handheld device outside the body – a similar process to the one employed by state-of-the-art cardiac pacemakers.

“This technology would be incredibly exciting,” Webster said. “It could significantly improve patient health – and cut down on expensive diagnostic tests and surgery. We still have a long way to go to make an intelligent implant a reality, but our new results are a strong first step.”

Webster’s Brown research team included engineering graduate student Sirinrath Sirivisoot, the lead author of the *Nanotechnology* article, engineering graduate students Chang Yao and Xingcheng Xiao and professor of engineering Brian Sheldon.

The Coulter Foundation funded the research.

Editors: Brown University has a fiber link television studio available for domestic and international live and taped interviews and maintains an ISDN line for radio interviews. For more information, call the Office of Media Relations at (401) 863-2476.

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