PROJECT FACTS

UNIVERSITY OF KENTUCKY CENTER FOR APPLIED ENERGY RESEARCH

CARBON MATERIALS

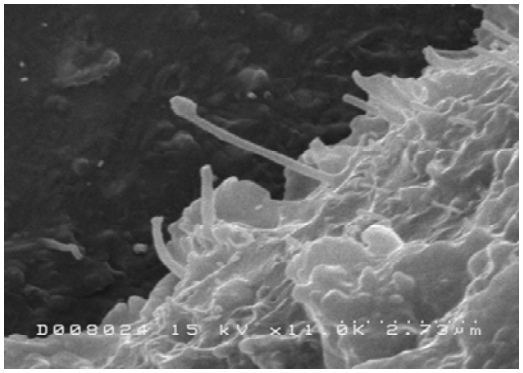
Augmenting Acrylic Bone Cement with Multiwall Carbon Nanotubes

Acrylic bone cement is widely used throughout the orthopedic and dental industries. Specific applications range from total joint arthroplasty to dental implant fixation. Although bone cement has an admirable track record, there exists room for improvements. The primary mode of bone cement failure *in vivo* has been broken down into four components: crack formation, slow crack propagation, fast crack propagation, and failure. Many studies have attempted to combat this failure mechanism by including strengthening additives such as carbon fiber, Kevlar fiber, glass beads, and titanium meshes. Although these studies showed that addition of these additives improved the mechanical properties of bone cement, the improvements were minor.

The recent discovery of multiwall carbon nanotubes (MWNTs) re-opened the door for improving bone cement. The unparalleled mechanical properties of MWNTs make this new material unique. To exploit these mechanical properties, the CAER is producing composite materials of acrylic bone cement and MWNTs. Not only is the focus on improving mechanical performance, but there is interest in determining loading of MWNTs at which these improvements are optimized.

The composite materials were mechanically tested in quasi-static modes (3-point bending, tension) as well as in fatigue (4-point bending, fully reversed tension-compression). The presence of MWNTs in the bone cement matrix should arrest fatigue crack growth and allow stress to transfer from the matrix to the MWNTs, ultimately increasing the mechanical strength and improving the fatigue properties.

As produced acrylic bone cement powder.



SEM of bone cement matrix on tip of nanotube

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