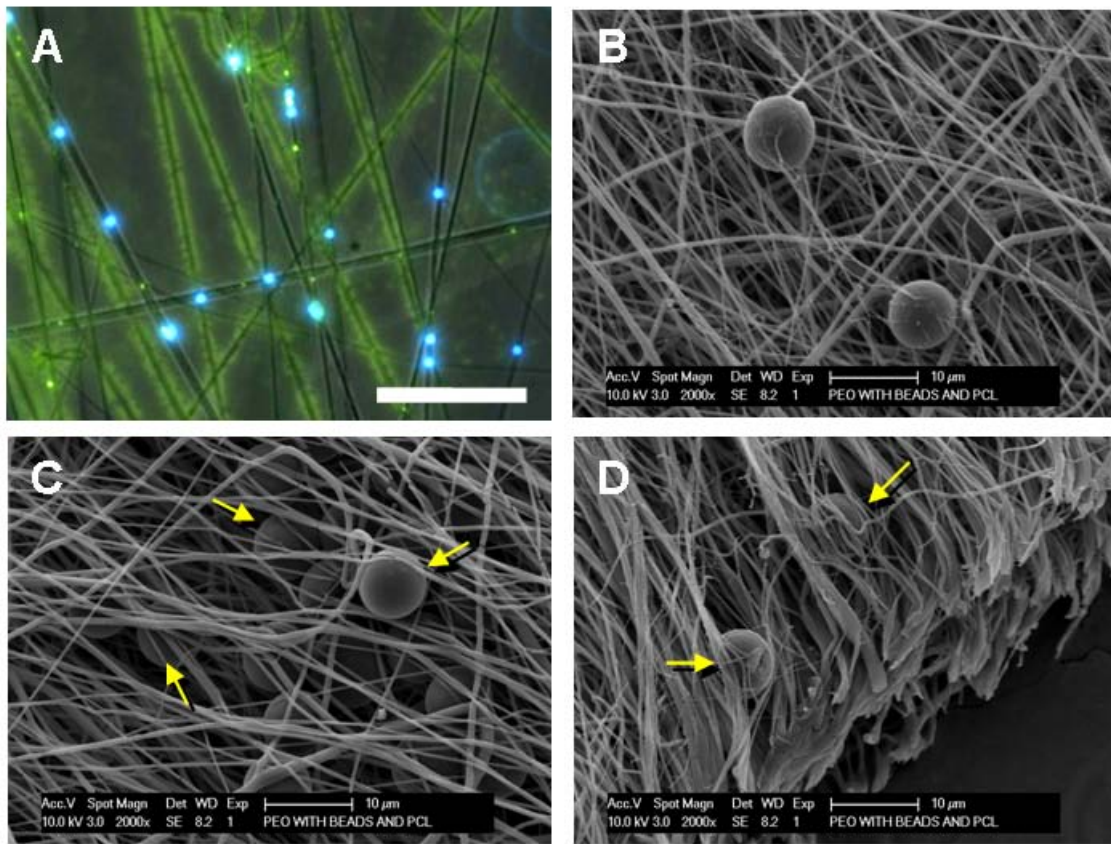


## Drug-Delivering Nanofibrous Composites for Fibrous Tissue Engineering

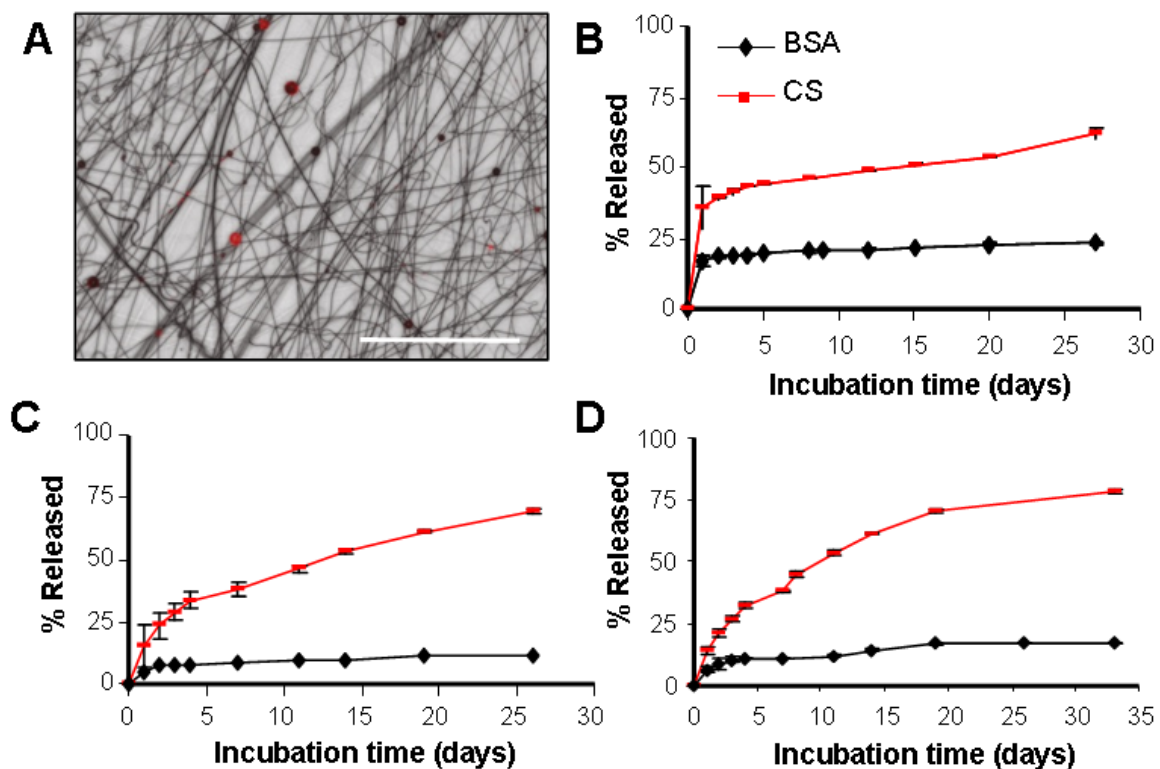
Fibrous tissues are characterized by a dense, ordered collagenous structure that defines their unique and anisotropic mechanical properties. To improve repair potential, engineering methods based on electrospinning have produced aligned and anisotropic scaffolds that direct new tissue formation. Delivery of growth factors or other chemicals may improve fibrous tissue formation or direct specialized functionalities (i.e., angiogenesis). We have developed a novel fabrication technique that entraps biodegradable microspheres (MS) in a dose-dependent manner between electrospun structural poly( $\epsilon$ -caprolactone) (PCL) fibers, using a sacrificial poly(ethylene oxide) (PEO) delivery fiber. Further, we have shown that incorporation of MS between fibers has less impact on the mechanical properties than placing MS in the fibers. Long-term release studies demonstrate that multiple model agents can be released from this composite structure in a sustained manner. Future work will explore the release of relevant growth factors both in vitro and in



vivo.

### Figure 1 – Realization of composite MS-laden scaffolds with sacrificial content.

Bright-field with overlaid fluorescent image (A, 4X, Scale bar = 50  $\mu$ m) and SEM (B, Scale bar = 20  $\mu$ m) of PEO/PCL/MS composite. In (A), blue shows MS, green shows PCL fibers, and black shows sacrificial PEO fibers within the composite structure. After PEO removal, microspheres remain entrapped and distributed between the remaining PCL fibers (C and D, arrows, Scale bar = 10  $\mu$ m).



**Figure 2 – Controlled release from composite MS-laden scaffolds.** (A) Overlay of light and fluorescent micrographs showing mixed MS population (BSA MS = red, CS MS = black, scale bar = 250  $\mu$ m). (B) Sustained release of bovine serum albumin (BSA) or chondroitin sulfate (CS) from PLGA microspheres with time in physiologic conditions. (C) Sustained release of BSA and CS from composite PCL/PEO-MS scaffold containing either BSA or CS microspheres. (D) Sustained release of both BSA and CS from a single composite system containing both BSA and CS microspheres at a 1:1 ratio.

### Recent Publications:

1. L.C. Ionescu, G.C. Lee, B.J. Sennett, J.A. Burdick, R.L. Mauck. "An Anisotropic Nanofiber/Microsphere Composite with Controlled Release of Biomolecules for Fibrous Tissue Engineering" *Biomaterials*, in press, NIHMS172318.
2. L.C. Ionescu, G.C. Lee, B.J. Sennett, J.A. Burdick, R.L. Mauck. "Combinatorial Drug Delivery from an Aligned Nanofiber/Microsphere Composite for Fibrous Tissue Engineering" *Orthopedic Research Society Annual Conference*, New Orleans, LA, 2010.
3. L.C. Ionescu, B.M. Baker, J.A. Burdick, R.L. Mauck. "Fabrication of Drug Delivering Biodegradable Microsphere/Nanofiber Networks" *The Orthopedic Research Society Annual Conference*, 1336, Vol.34, Las Vegas, NV, 2009.
4. L.C. Ionescu, B.M. Baker, J.A. Burdick, R.L. Mauck. "A Composite Microsphere/Nanofiber Controlled Release System for Fibrous Tissue Engineering".

American Society of Mechanical Engineers Summer Bioengineering Conference, Lake Tahoe, CA, 2009.

5. R.L Mauck, B.M. Baker, L.C. Ionescu, N.L. Nerurkar, J.A. Burdick. "Multi-functional and dynamic fibrous scaffolds for tissue engineering and controlled release." Materials Research Society Conference, Boston, MA, 2009.

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