Spatially organized biomaterials to direct functional tissue regeneration

LESLEY W. CHOW
FRANK HOOK ASSISTANT PROFESSOR
MATERIALS SCIENCE & ENGINEERING/BIOENGINEERING
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LEHIGH UNIVERSITY | Department of Bioengineering

Lesley W. Chow, PhD

EDUCATION AND TRAINING

- B.S., Materials Science and Engineering, University of Florida
- Ph.D., Materials Science and Engineering, Northwestern University
- Postdoc, Materials & Bioengineering, Imperial College London

KEY PUBLICATIONS

- P. Camacho, H. Busari, K. B. Seims, P Schwarzenberg, H. L. Dailey, L. W. Chow, “3D printing with peptide-polymer conjugates for single-step fabrication of spatially functionalized scaffolds”, *Biomaterials Science* 7: 4237-4247, 2019.
- P. Camacho, H. Busari, K. B. Seims, J. W. Tolbert, L. W. Chow, “Materials as bioinks and bioink design”, *3D Bioprinting in Medicine* (Ed. M. Guvendiren), 67-100, 2019.
- L. W. Chow, J. F. Fischer, “Creating biomaterials with spatially organized functionality”, *Experimental Biology and Medicine* 241(10): 1025-1032, 2016.

KEYWORDS FOR RESEARCH INTERESTS

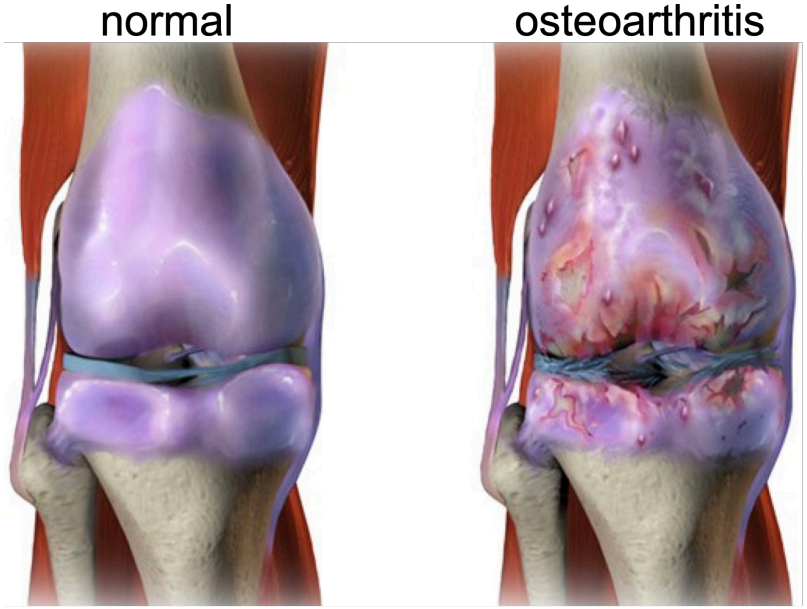
biomaterials, musculoskeletal tissue engineering, additive manufacturing, regenerative medicine, peptides, biodegradable polymers

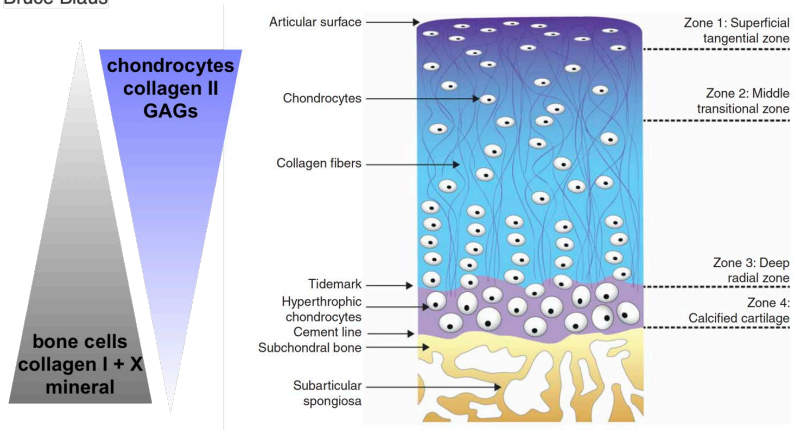
What is the physiology / pathology being studied?

- Osteochondral (bone-cartilage) interface
- Cartilage injury and repair
- Post-traumatic osteoarthritis (PTOA)

Why is this topic significant?

- Osteoarthritis (OA) is the most common joint disease worldwide with 12% of all OA resulting from injury or trauma (PTOA)
- OA treatments like artificial joint replacement are less acceptable for younger patients who will likely outlive their implants and require revision surgery
- Younger patients need early-stage interventions after injury to prevent or delay the progression of PTOA and OA
- Current surgical techniques to repair cartilage defects typically result in poorly organized tissues that fail to restore tissue function



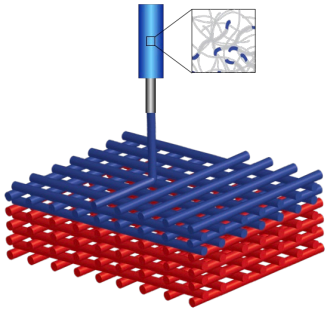


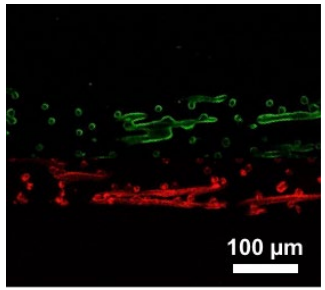
How is this topic studied/addressed?

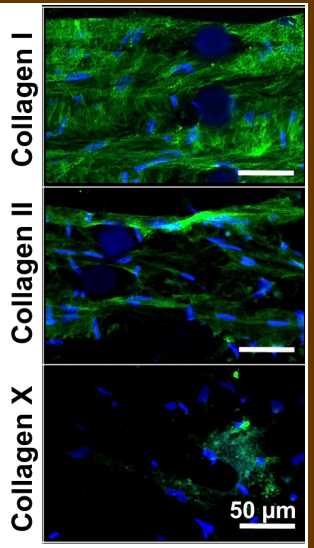
- peptide-polymer conjugates with cartilage-promoting and bone-promoting sequences
- 3D-printed scaffolds with multi-peptide organization to direct spatial cell response and matrix formation to mimic native tissue
- *in vitro* cell culture experiments with human mesenchymal stem cells (hMSCs)

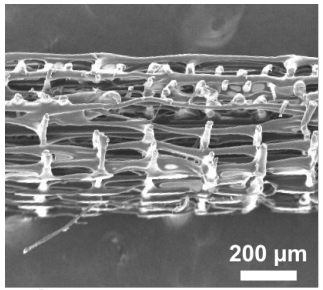
What are the future directions of this research?

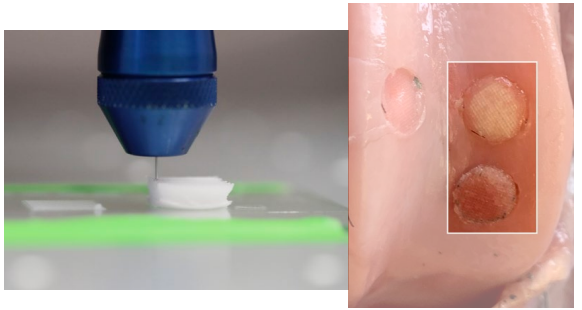
- 3D-printed scaffolds with physical properties (architecture, mechanics, degradation) that support spatial tissue regeneration
- *ex vivo* studies in goat osteochondral explant tissues using bone marrow aspirate
- *in vivo* studies in a critical-sized osteochondral defect model (rabbits, goats) to investigate *in situ* tissue formation with endogenous cells
- growth factor-mimicking peptide sequences

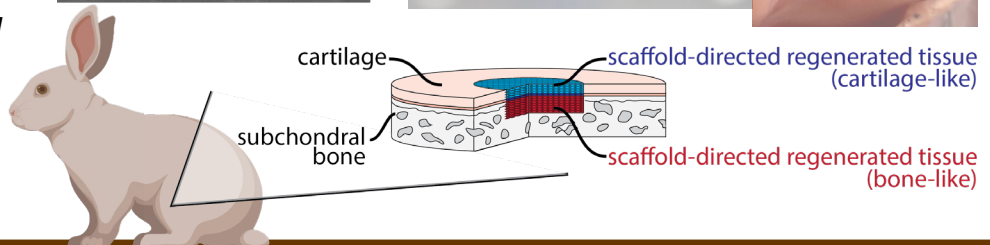




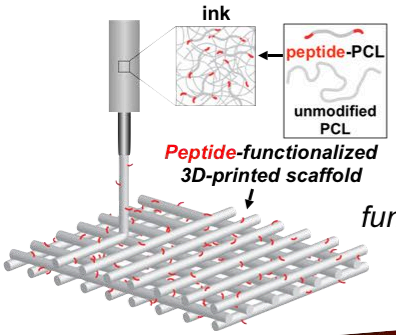






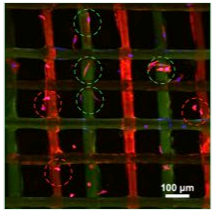


Modular Biomaterials Laboratory

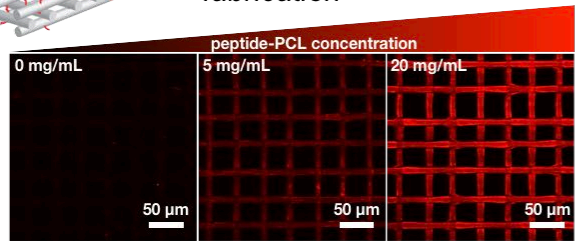


functionalization during fabrication

fiber-level control of cell behavior

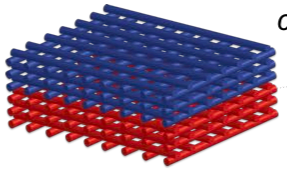


controllable peptide concentration



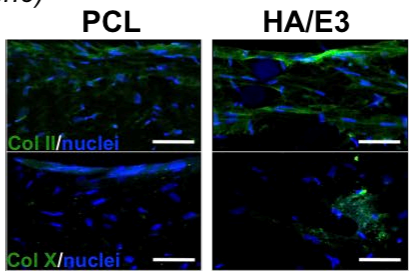
spatially organized bioactive cues

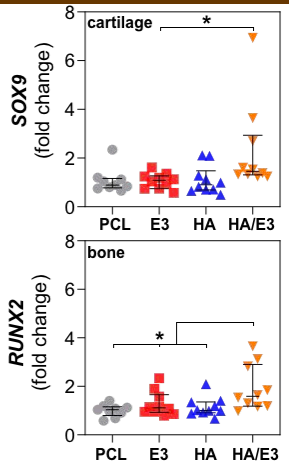
HAbind *(cartilage)*



continuous scaffold with distinct peptide regions

E3 *(bone)*

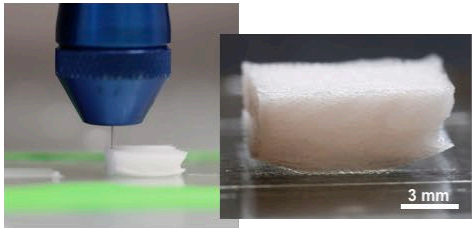




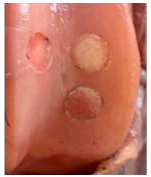
synergistic effect of dual-peptide presentation on stem cell response

Camacho*, Busari*, Seims, Schwarzenberg, Dailey, Chow. *Biomaterials Science*, **2019**, 7, 4237-4247.

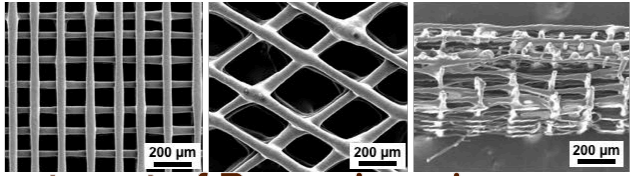
tunable scaffold architecture



scalable platform for in vivo translation

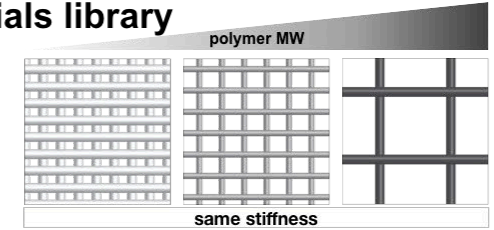


user-defined scaffold architecture

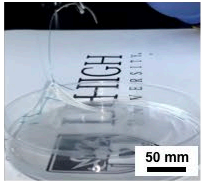


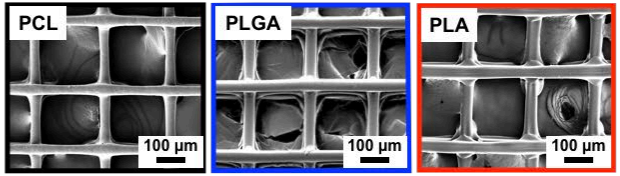
adaptable materials library

tunable polymer molecular weight



natural/synthetic polymer blend membranes





tailorable bulk polymer

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Paula Camacho
Diana Hammerstone
Nicole Malofsky
Kelly Seims
John Tolbert

Undergraduate Students:
Libby Andrews
Yaa Donkor
Natasha Hunt
Sareena Karim
Vaughan Kramer
Nate Yuchimiuk

Collaborators:
Dr. Hannah Dailey (Lehigh)
Dr. William De Long (SLUHN)
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Dr. Brandon Krick (FSU)
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Matthew Fainor (Heo/Mauck @UPenn)
Kevin Kim
Sydney Yang (Duncan @UMD)

LEHIGH UNIVERSITY | Department of Bioengineering
thechowlab
lesley.chow@lehigh.edu