

# Chemical Engineering Doctoral Defense

## Designing Gradient Scaffolds for Complex Tissue Engineering

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### Abstract

Tissues within the body enable proper function throughout an individual's life. After severe injury or disease, many tissues do not fully heal without surgical intervention. The current surgical procedures aimed to repair tissues are not sufficient to fully restore functionality. To address these challenges, current research is seeking new tissue engineering approaches to promote tissue regeneration and functional recovery. Of particular interest, biomaterial scaffolds are designed to induce tissue regeneration by mimicking the biophysical and biochemical aspects of native tissue. While many scaffolds have been designed with homogenous properties, many tissues are heterogenous in nature. Thus, fabricating scaffolds that mimic these complex tissue properties is critical for inducing proper healing after injury. Within this dissertation, scaffolds were designed and fabricated to mimic the heterogenous properties of the following tissues: (1) the vocal fold, which is a complex 3D structure with spatially controlled mechanical properties; and (2) musculoskeletal tissue interfaces, which are fibrous tissues with highly organized gradients in structure and chemistry. A tri-layered hydrogel scaffold was fabricated through layer-by-layer stacking to mimic the mechanical structure of the vocal fold. Furthermore, magnetically-assisted electrospinning and thiol-norbornene photochemistry was used to fabricate fibrous scaffolds that mimic the structural and chemical organization of musculoskeletal interfacial tissues. The work presented in this dissertation further advances the tissue engineering field by using innovative techniques to design scaffolds that recapitulate the natural complexity of native tissues.



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Zoom Link: <https://asu.zoom.us/j/88592054912>