Design of Biomimetic Polymeric Biomaterials

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Statistical design of experiments (DOE) can be used to facilitate rapid screening and optimization of candidate biomaterials. DOE is an efficient alternative to exhaustive search methods and is an underutilized tool that improves efficiency and reduces costs. The optimized design of biomaterials can be used to develop biomimetic materials to replace damaged or diseased tissues and as drug delivery scaffolds. This methodology was applied to the development of an in vivo forming biomimetic vitreous substitute, which matched the viscoelastic and optical properties of the natural vitreous humor. These hydrogel systems employed a reversible disulfide crosslinker that enabled these hydrogels to be injected as a liquid and form in the ocular cavity.

Tissue engineering requires proper mechanical and biological cues to promote cell adhesion and differentiation. Components of the extracellular matrix were incorporated into collagen gels to determine their effects on neurite extension in three-dimensional scaffolds. Rheology was used to determine the impact of the additives on the physical properties of the gels to determine the biological and mechanical cues that optimize neurite extension in a tissue engineering scaffold. In addition, electrospinning was used to produce nanofibrous scaffolds for use in peripheral nerve regeneration.