Tunable Nanostructured Gels for Emerging Applications

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Abstract

The emergence of genetic engineering of synthetic polypeptides has recently enabled to synthesize protein-based polymers artificially. Biomimetic elastomer, particularly elastin or resilin has been of significant interest to understand the molecular basis of its elasticity. It has also been identified that they could be used as 3D gels, nanoparticles, fibres, and injectable gels. The biological properties of these biomaterials can be tuned by proteins engineering or by fusion with other protein or using graphene to control cell response for wide range of tissue engineering applications e.g. muscles, spinal disc, and cartilage. In this work, we fuse resilin, a soft elastic protein, with a rigid material such as silk (RSF) or graphene to tune toughness at a level required for artificial disc and understand the structure-property relationship. The elastic modulus of the fabricated gels particularly RSF-GO hydrogel is greater than those of most traditional hydrogels, double-network hydrogels, mammalian cardiac and skeletal muscles, increased to 8.2 MPa with GO reinforcement. The elastic modulus of the hydrogels can be tuned between 1-21MPa, through GO reinforcement, post-treatment, and hydration level making them suitable for potentials applications in tissue engineering, protective molecular coatings and bioelectronics.

References

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Figures

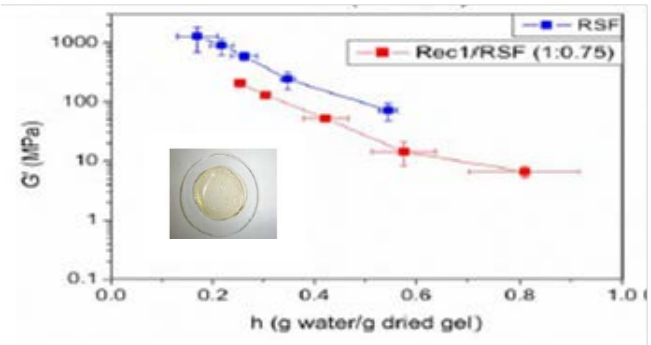

Figure 1: Elastic modulus of DN Gel [6]; Inset figure: Swollen gel in PBS

Figure 2: GO integrated biopolymer solution before gelation