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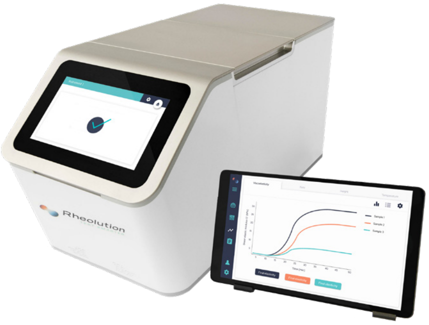
LIFE SCIENCES

Application note | ElastoSens™ Bio

Analysis of UV crosslinked hydrogels using ElastoSens™ Bio



ELASTOSENS™ BIO

PHOTO STIMULATION

THERMO STIMULATION

BIOLOGICAL MATERIALS

BIO CHEMISTRY

SUMMARY

— The evaluation of the mechanical properties of UV-crosslinked hydrogels is conventionally performed with destructive techniques.

— ElastoSens™ Bio allowed multiple tests on the same UV-crosslinked hydrogels under progressive exposure to UV light and controlled temperature.

— Longer exposure time to UV light increased the stiffness of methacrylated hyaluronic acid and gelatin but no influence was observed for methacrylated collagen.

INTRODUCTION

Hydrogels have been widely used in biomedical research for developing engineered tissues and novel treatments such as wound dressings and drug delivery systems. Photo-crosslinkable polymers are an interesting option in the field due to the possibility of tuning its microstructure by regulating the wavelength, intensity and duration of the applied light [1, 2, 3]. The modulation of the hydrogel microstructure is important for tailoring the mechanical properties of 3D matrices or for the release of drugs from hydrogels. The evaluation of the hydrogel mechanical properties during or after exposure to UV light is usually performed with destructive testing techniques such as rheometry and compression testing. However, this prevents the re-use of the gel for further characterization. Furthermore, destructive techniques require multiple samples to test the mechanical stability of UV crosslinked gels over long periods of time. In this short application note, the ElastoSens™ Bio was used to measure the viscoelastic properties of different hydrogels from Advanced BioMatrix (CA, USA), a leading provider of biologically derived hydrogels, after different exposure times to UV light.

MATERIALS AND METHODS

Methacrylated collagen 0.6 % (PhotoCol®, 6 mg/mL), methacrylated hyaluronic acid 1% (PhotoHA®, 1 mg/mL) and methacrylated gelatin (PhotoGel®, 100 mg/mL) were pipetted in the ElastoSens™ Bio sample holders with the photoinitiator Irgacure 2959 and transferred to an UV (365 nm) chamber for irradiation for 5 or 10 minutes at 37 °C or room temperature. The same PhotoCol® samples were tested on the ElastoSens™ Bio before and right after exposure to UV light.

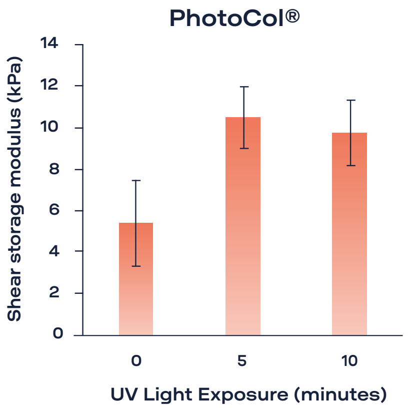


Fig. 1: Shear storage modulus (G') of PhotoCol® before and after exposure to 365nm UV light for 5 or 10 minutes at 37°C.

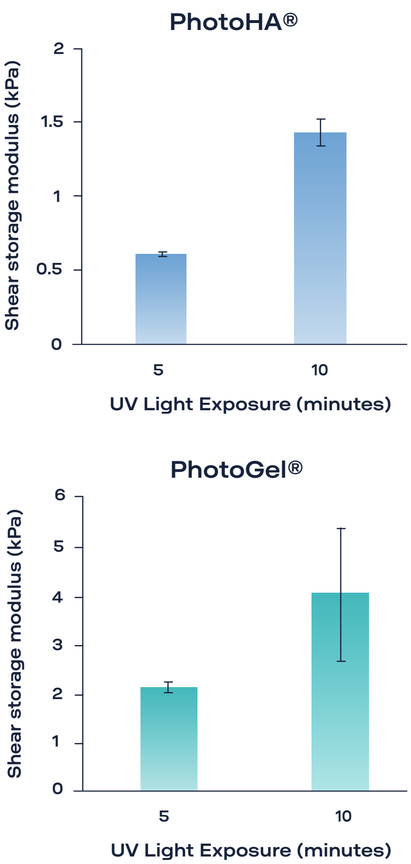


Fig. 2: Shear storage modulus (G') of PhotoHA® and PhotoGel® after exposure to UV light for 5 or 10 minutes at room temperature

RESULTS AND DISCUSSION

Fig. 1 shows the shear storage modulus (G') of the PhotoCol® methacrylated collagen before and after exposure to UV light for 5 and 10 minutes at 37 °C. The collagen molecules are known to self-assemble by hydrogen bonds, and electrostatic and hydrophobic interactions at room (or higher) temperature. For this reason, elasticity measurement was possible even prior to UV light exposure. The UV light-mediated crosslinks increased the hydrogel stiffness after 5 minutes of exposure and no difference was observed after longer time (10 minutes). This indicates that crosslinking was completed after 5 minutes of exposure to UV light.

Fig. 2 shows the shear storage modulus (G') of PhotoHA® and PhotoGel® after exposure to UV light for 5 or 10 minutes at room temperature. Their increasing G' shows that they were not fully crosslinked after 5 minutes of exposure to UV light. At these concentrations, the HA-based hydrogels were softer than gelatin-based UV-crosslinked hydrogels.

CONCLUSION

The use of UV light and Irgacure to induce the crosslinking of methacrylated groups increased the stiffness of the PhotoCol® collagen when compared to the self-assembled gel (no exposure to UV light). However, UV light exposure time (5 or 10 minutes) did not affect its stiffness. On the other hand, 10 minutes of exposure to UV light led to higher storage modulus for the PhotoHA® and PhotoGel® when compared to 5 minutes of exposure.

PERSPECTIVES

— ElastoSens™ Bio is an easy-to-use, non-destructive and contact free instrument that measures the viscoelasticity of hydrogels.

— Testing the same sample over short or long periods of time is now possible due to the non destructive nature of the technology.

— ElastoSens™ Bio allows testing the viscoelasticity of biomaterials under different physical (e.g. photo or thermo stimulation), chemical (e.g. crosslinking solution) and physiological (e.g. enzymatic solution) conditions to simulate *in vivo* behaviors.

— ElastoSens™ Bio can be used for R&D, quality control of production and pre-clinical studies. Combined with Soft Matter Analytics™ capabilities, it offers a unique testing platform.

REFERENCES

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