A Study of pH-responsive Microgel Dispersions with Potential Application in Soft Tissue Repair

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An interesting, and potentially important, challenge for polymer colloid scientists is to design injectable dispersions that enable repair of damaged and diseased tissue. In our previous work it was demonstrated that poly(EA/MAA/BDDA) (ethylacrylate, methacrylic acid and butanediol diacrylate) microgel dispersions were able to provide pH-triggered structural support for degenerated intervertebral discs (IVDs) subjected to biomechanically meaningful loads[1]. Microgel particles are crosslinked polymer colloid particles that swell[2]. The next step in our programme for IVD repair is to prepare pH-responsive microgels which are biocompatible. In this work we present new results obtained using poly(MMA/MAA/EGDMA) (methylmethacrylate and ethyleneglycol dimethacrylate) microgel dispersions. All of the components in these particles can be found in biomaterial devices already used in the body. The poly(MMA/MAA/EGDMA) particles investigated in this work are shown to exhibit more pronounced pH-triggered swelling transitions than poly(EA/MAA/BDDA). Gelation-phase maps for the dispersions were obtained which revealed that gelled microgel dispersions form when the polymer volume fraction and pH exceed 0.035 and 6.2, respectively. The rheological properties were investigated and compared with those obtained previously for poly(EA/MAA/BDDA) dispersions. It is shown that the elastic modulus obtained for all of the microgels reside on a master curve. Furthermore, the elastic modulus can be predetermined using dispersion composition. This should enable enhanced control of the mechanical properties within IVDs in the future. Finally, preliminary cell challenge experiments reveal that poly(MMA/MAA/EGDMA) has good biocompatibility for cells found within IVDs.

References

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