Design and characterization of Hybrid gelatin/PEGDA hydrogels with tunable viscoelastic properties

Salvatore Costanzo [a], Pietro Renato Avallone [a], Nadia Russo [a], Nicola Gargiulo [a] and Nino Grizzuti [a]

[a] Department of Chemical, Materials and Production Engineering, University of Naples Federico II, P.le Tecchio 80, Naples 80125, Italy

E-mail: *salvatore.costanzo@unina.it*

We report on the formulation and characterization of hybrid hydrogels composed of gelatin and poly(ethylene glycol) diacrylate (PEGDA). Such hydrogels undergo sol-gel transitions either reversibly, via temperature variation, or irreversibly, via UV-photopolymerization. By finely tuning the interplay between physical (thermal) and chemical (UV-induced) gelation mechanisms, a broad spectrum of viscoelastic properties and swelling ratios can be achieved. We sistematically investigate the effects of PEGDA concentrations and the preparation protocol on the gelation kinetics and the mechanical properties, morphology, and swelling of the resulting hydrogels. Rheological measurements demonstrate that a higher gelatin content promotes faster physical gelation and enhances the elastic properties, while UV-triggered PEGDA crosslinking competes with and modifies the physical network, especially at elevated PEGDA levels. SEM analysis reveals that increasing PEGDA leads to denser microstructures with reduced porosity. Swelling tests indicate that lower PEGDA concentrations result in greater water uptake. Our findings highlight the synergistic interactions between reversible and irreversible crosslinking mechanisms and their role in modulating the final hydrogel properties. The tunability of this system offers promising potential for biomedical applications that require customizable mechanical behavior and morphological characteristics.

This work is funded by the European Union - Next Generation EU.

Keywords: *hydrogels, viscoelasticity, rheology*