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Polymer physics to investigate the elastic properties of bundled hydrogels : applications to collagen gels.

Collagen gels are ubiquitous materials found in biological tissues, serving as structural support, regulating cellular processes, or contributing to wound healing.
Multiple models elucidate their tensile behavior through the lens of polymer physics \[1\].
Nevertheless, the characteristics of these gels under hydrodynamic pressure remain largely unexplored. Our recent findings highlight the varied behavior of these gels, dependent on whether they experience tensile or compressive stress. \[2\]
Here we report a poroelastic response model for collagen gels, integrating large-scale hyperelastic models with polymer deformation at the microscale.
Our proposal suggests that the asymmetric elasticity arises from the interplay of physical and chemical interactions within the gel, attributable to cross-links and self-avoidance mechanisms, respectively. Thus, the elastic properties of soft hydrogels seem to be highly adaptable, contingent upon their microscopic architecture. We further propose that this model holds promise for extension to a wide range of hydrogels, including those composed of DNA.

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