



## FRONTIERS IN MICRORHEOLOGY



### Mechanical and morphological characterization of reconstituted collagen type I networks on different length scales

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**Abstract:** Macrorheological measurements of collagen gels (2.4mg/ml of a 1:1 mixture of bovine and rat collagen type I, assembled at pH 10) using a parallel-plate rheometer revealed predominantly elastic behavior that was approximately linear for strains <3-5%, showing a weak frequency dependency of both, storage and loss moduli, according to a power-law. For exceeding strains, collagen gels showed non-linear strain-stiffening until loss of network integrity at about 40-50% strain. 3D reconstructions of confocal images of fluorescently labeled collagen gels were used to determine the size distribution of 3-dimensional pores of the network. Microrheology of the gels was measured by means of a high-force magnetic tweezers setup, applying a step protocol of forces ranging from 0.5 to 20nN to Ø4.5µm ferrimagnetic beads embedded close to the surface of the gel. Evaluation of numerous locations yielded a wide spread in local elastic moduli, yet showed a similar trend in strain-stiffening during force application. The average local properties corresponded roughly to those measured for the bulk. Furthermore, the strain field during deformation of the samples was visualized during point force application onto the surface, spherical indentation (Ø100µm) of the surface and parallel shear of the sample between two glass plates by tracking the 3D positions of dispersed fluorescent marker beads (Ø1µm).



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