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Hydrogels with tuneable dissipation for mechanotransduction studies

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There is a need for the development of hydrogel substrates with tuneable dissipation properties for various applications such as orthopedic load-bearing applications and scaffolds for cell culture. Tuning of stiffness and toughness by using double network gels consisting of two polymer networks has been explored for such applications. However, the mechanical properties of such hydrogels are often hindered by swelling. Moreover, the development of hydrogels with stable mechanical properties and tuning of dissipation in such hydrogels remains a challenge. Recently, there has been considerable research interest in using hydrogels with tuneable loss modulus, or dissipation properties as substrates in studies of cellular mechanotransduction.
In our research, we explored the influence of polymerizing monomers inside a crosslinked polymer network. The second networks were designed to hydrogen bond with the first crosslinked polymer network. Specifically, we used acrylic acid and tannic acid as monomers which are polymerized inside a crosslinked gel to form linear poly(acrylic acid) chains and oligomeric poly(tannic acid), respectively. We systematically studied the mechanical properties of these two gels using tensile and compression tests. The hydrogels exhibited high stiffness and toughness, and the results can be attributed to the density of the hydrogen bonds between the polymers in the gel. As a proof of concept, we tested the possibility of producing gels with tuneable loss modulus without significant variations in the storage modulus by polymerizing the monomers under a printed UV mask. The obtained mechanical properties were studied using rheology. Finally, we tested the stability of such gels in cell culture conditions (37 ℃, PBS). We envisage that such hydrogel substrates will be helpful in studying cells' responses to different levels of loss modulus and loss modulus gradients. In future work, we plan to attach adhesion ligands on such substrates and investigate the combined effect of mechanical properties and ligand density on mechanotransduction.

Speakers Gender

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Level of Expertise

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Do you wish to take part in the poster slam

No

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