Supporting information

How Can Multi-Bond Network Hydrogels Dissipate Energy More Effectively: An Investigation on Relationship between Network Structure and Properties

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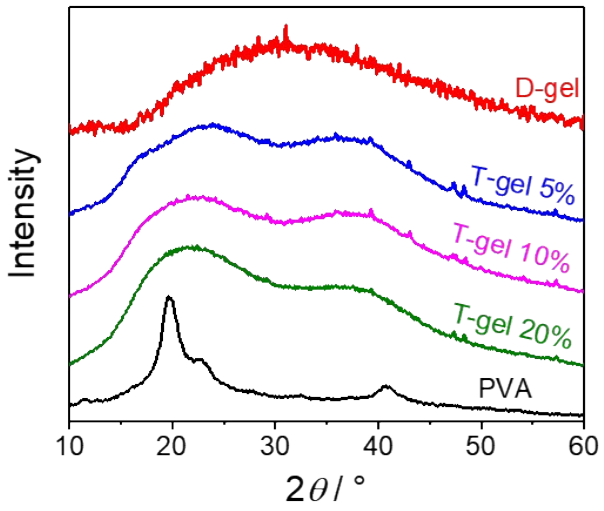

Figure S1. X-ray diffraction (XRD) curves of dual-crosslinked hydrogels (D-gel), ternary-crosslinked hydrogels (T-gels), and pure poly(vinyl alcohol) (PVA) powder. One can clearly identify the characteristic peak of PVA crystal at the 2θ value around 20°, of which the intensity becomes larger as the increase of PVA contents. It is worth mentioning that the peak is broader compared to that in the XRD curve of pure PVA powder. This indicates that the PVA microcrystals generated by freezing-thawing process have a wide size distribution.

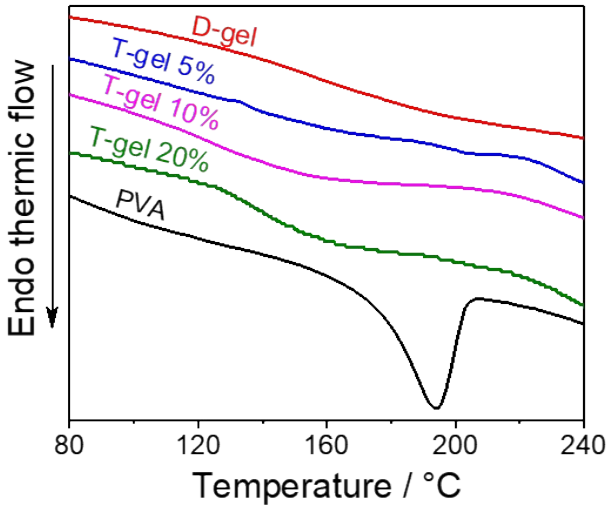

Figure S2. Differential scanning calorimeter (DSC) curves of D-gel, T-gels, and pure PVA powder. No obvious peaks can be found in T-gel 5% because the amount of PVA microcrystals is too low compared to the total amount of polymer. Curves of T-gels 10% and 20% display very broad peaks ranging from 125 to 200 ºC, which can be ascribed to the melting of PVA microcrystals. It can be inferred from the broad melting peak that there is a wide distribution in the size of PVA microcrystals, which is consistent with the result of XRD. The starting melting temperature of PVA microcrystals in T-gels is much lower than that in pure PVA powder, which is probably due to the incomplete crystallization.

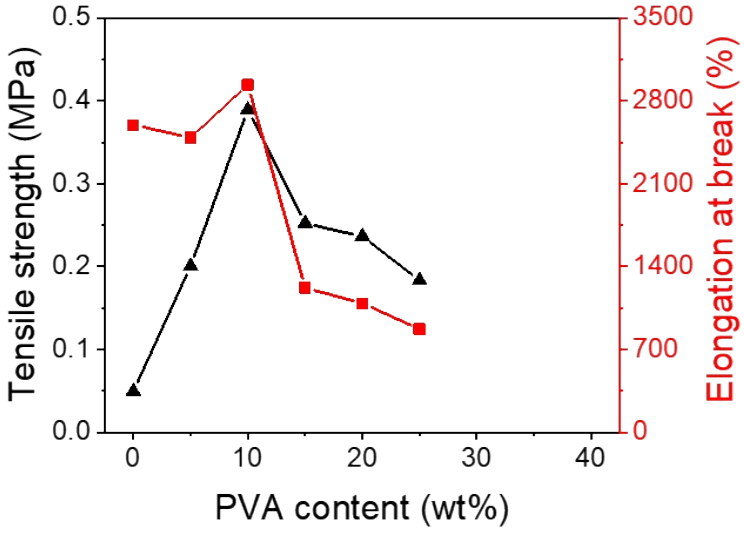

Figure S3. The changes of tensile strength and elongation at break of D-gel (a special T-gel in which PVA content is 0 wt %) and T-gels as a function of PVA content.

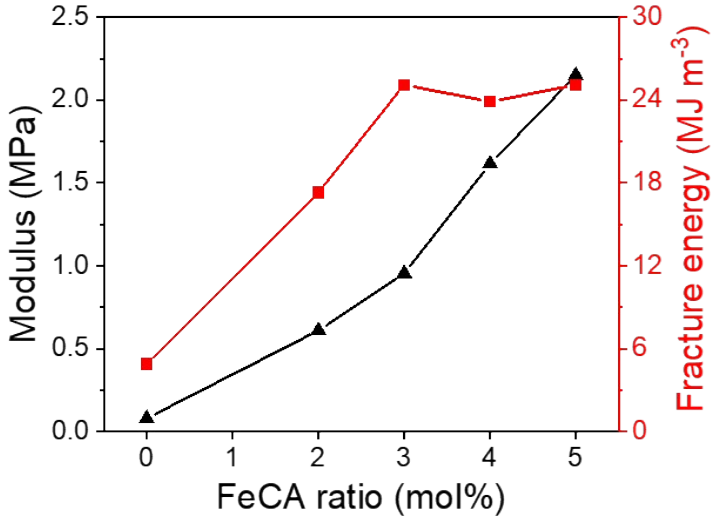

Figure S4. The changes of modulus and fracture energy of quaternary-crosslinked hydrogels (Q-gels) as a function of FeCA ratio.

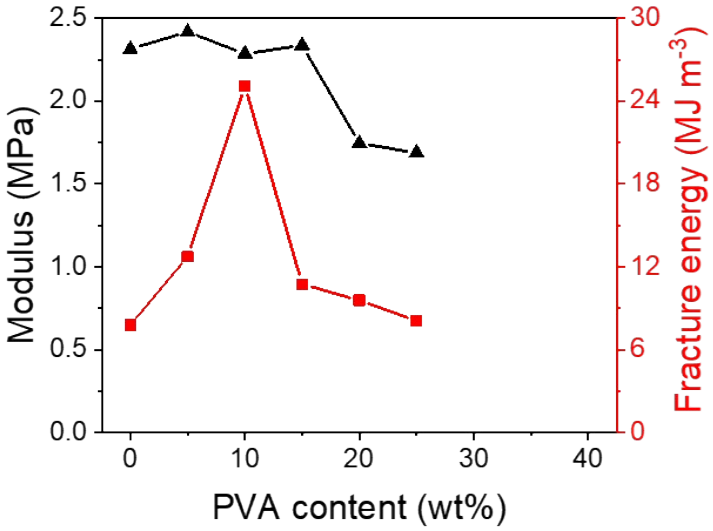

Figure S5. The changes of modulus and fracture energy of Q-gels as a function of PVA content.

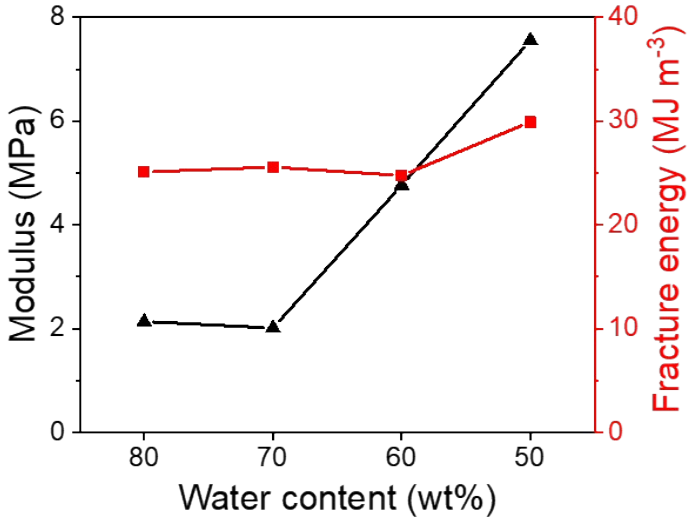

Figure S6. The changes of modulus and fracture energy of Q-gels as a function of water content.

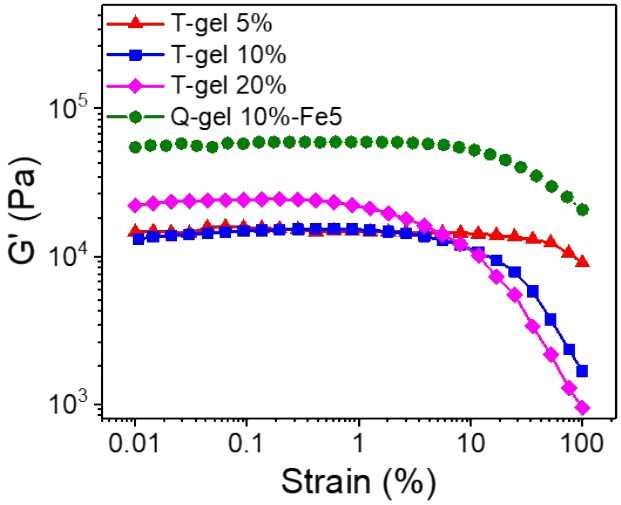

Figure S7. Rheological behavior of MBN hydrogels: storage modulus as a function of sweeping strain at a constant frequency of 1 Hz. All MBN hydrogels exhibit linear response in the strain range from 0.01 to 1%.