ADVANCED MATERIALS

Supporting Information

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Spanning Network Gels from Nanoparticles and Graph Theoretical Analysis of Their Structure and Properties

*Drew A. Vecchio, Mark D. Hammig, Xiongye Xiao, Anwesha Saha, Paul Bogdan, and Nicholas A. Kotov**

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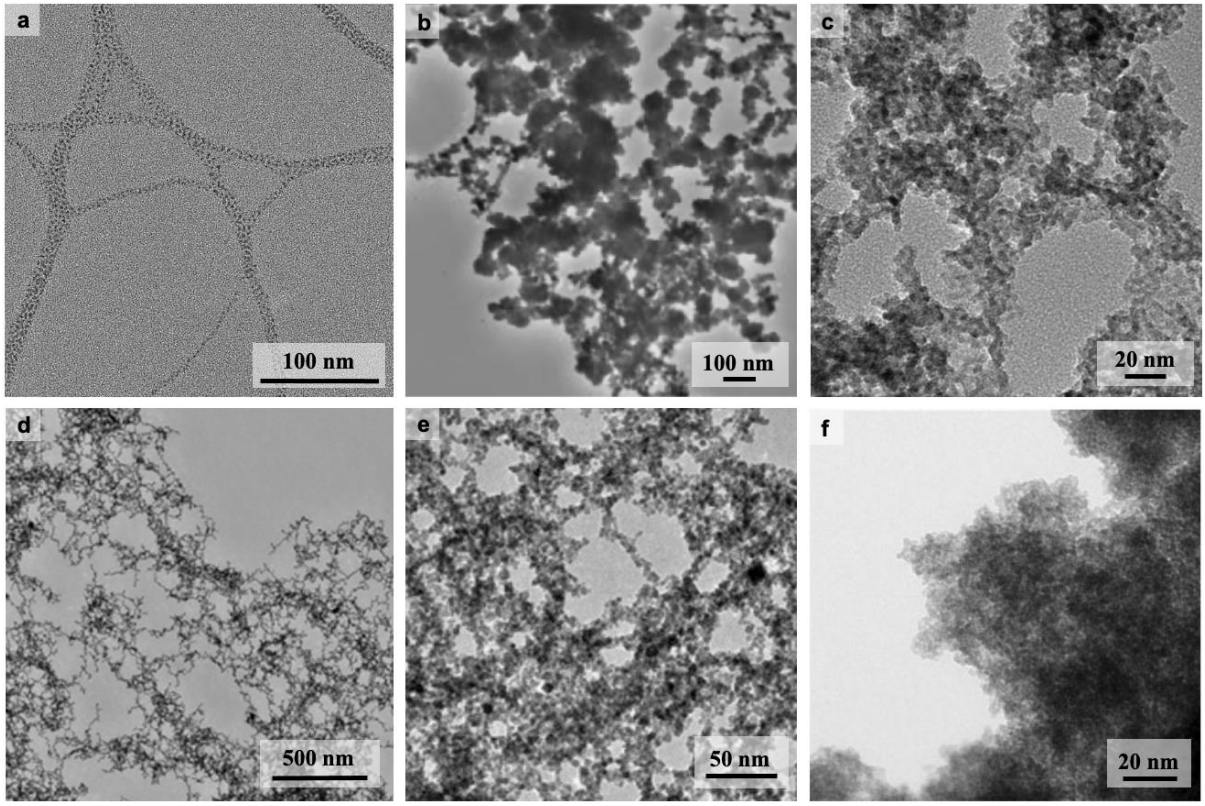


Figure S1: TEM images of various NP gels. a) The PbTe network nanogel described in this work. b) Aerogel from thiolated PbTe obtained after the addition of 3% H_2O_2 to achieve a concentration ratio of H_2O_2:Pb^{2+} = 1:11. Reproduced from S. Ganguly, S. L. Brock, *J. Mater. Chem.* **2011**, *21*, 8800 with permission from The Royal Society of Chemistry.[1] c) CdSe aerogel prepared from nanoparticles with 11-mercaptoundecanoic acid surface ligands and dispersed in acetone. Reprinted (adapted) with permission from I. U. Arachchige, S. L. Brock, *J. Am. Chem. Soc.* **2006**, *128*, 7964. Copyright 2006, American Chemical Society.[2] d) Bimetallic aerogel prepared from citrate-stabilized Au and Pd NPs. Reprinted (adapted) with permission from A.-K. Herrmann, P. Formanek, L. Borchardt, M. Klose, L. Giebeler, J. Eckert, S. Kaskel, N. Gaponik, A. Eychmüller, *Chem. Mater.* **2014**, *26*, 1074. Copyright 2014, American Chemical Society.[3] e) Pd aerogel prepared by cryogelation with liquid nitrogen. Reprinted with permission from A. Freytag, S. Sánchez- Paradinas, S. Naskar, N. Wendt, M. Colombo, G. Pugliese, J. Poppe, C. Demirci, I. Kretschmer, D. W. Bahnemann, *Angew. Chemie Int. Ed.* **2016**, *55*, 1200. Copyright 2015, John Wiley & Sons.[4] f) SnO_2 aerogel prepared through an epoxide-initiated gelation method. Reprinted with permission from T. F. Baumann, S. O. Kucheyev, A. E. Gash, J. H. Satcher Jr, *Adv. Mater.* **2005**, *17*, 1546. Copyright 2005, John Wiley & Sons.[5]

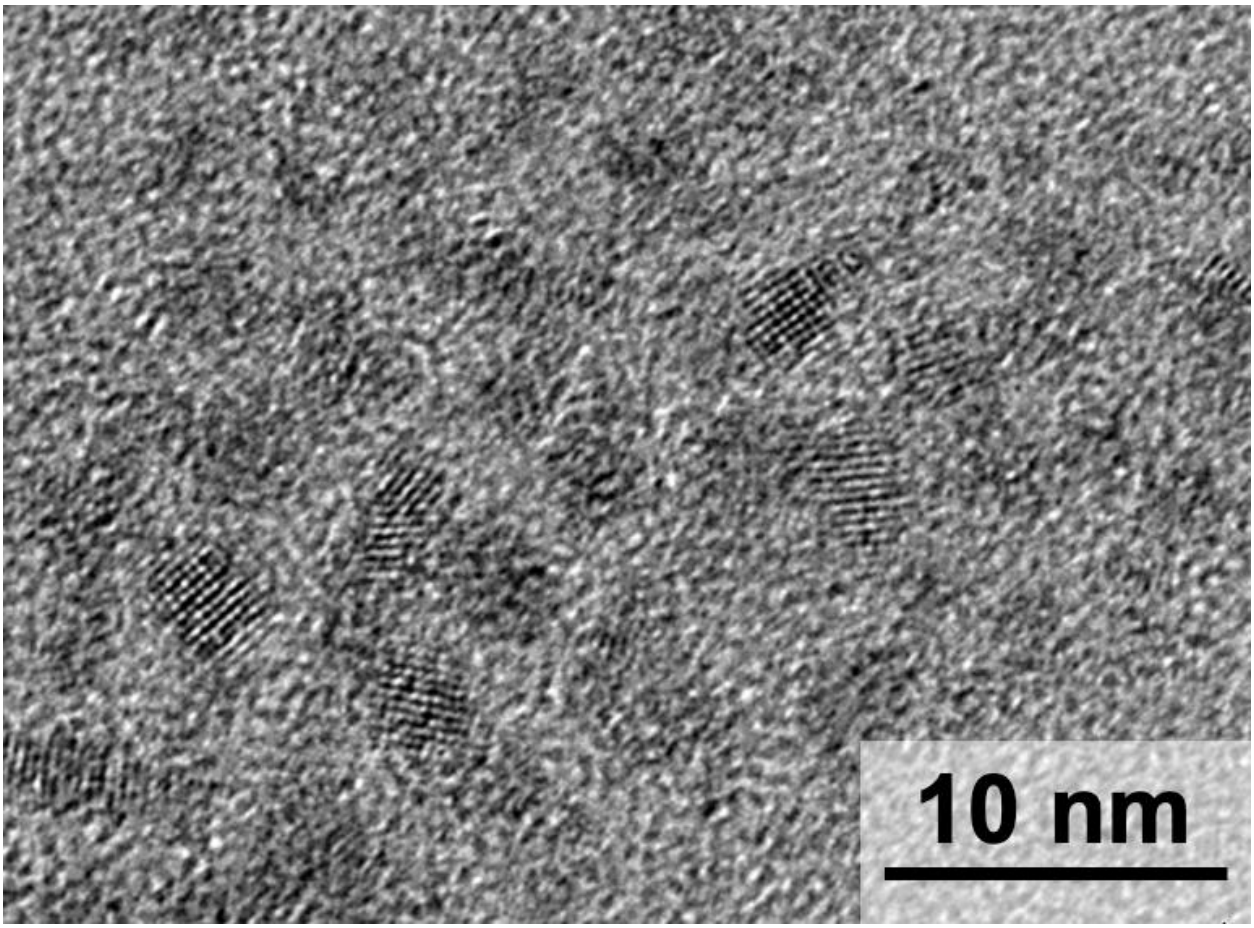


Figure S2: High magnification TEM image displaying lattice planes in Cit.-PbTe NPs.

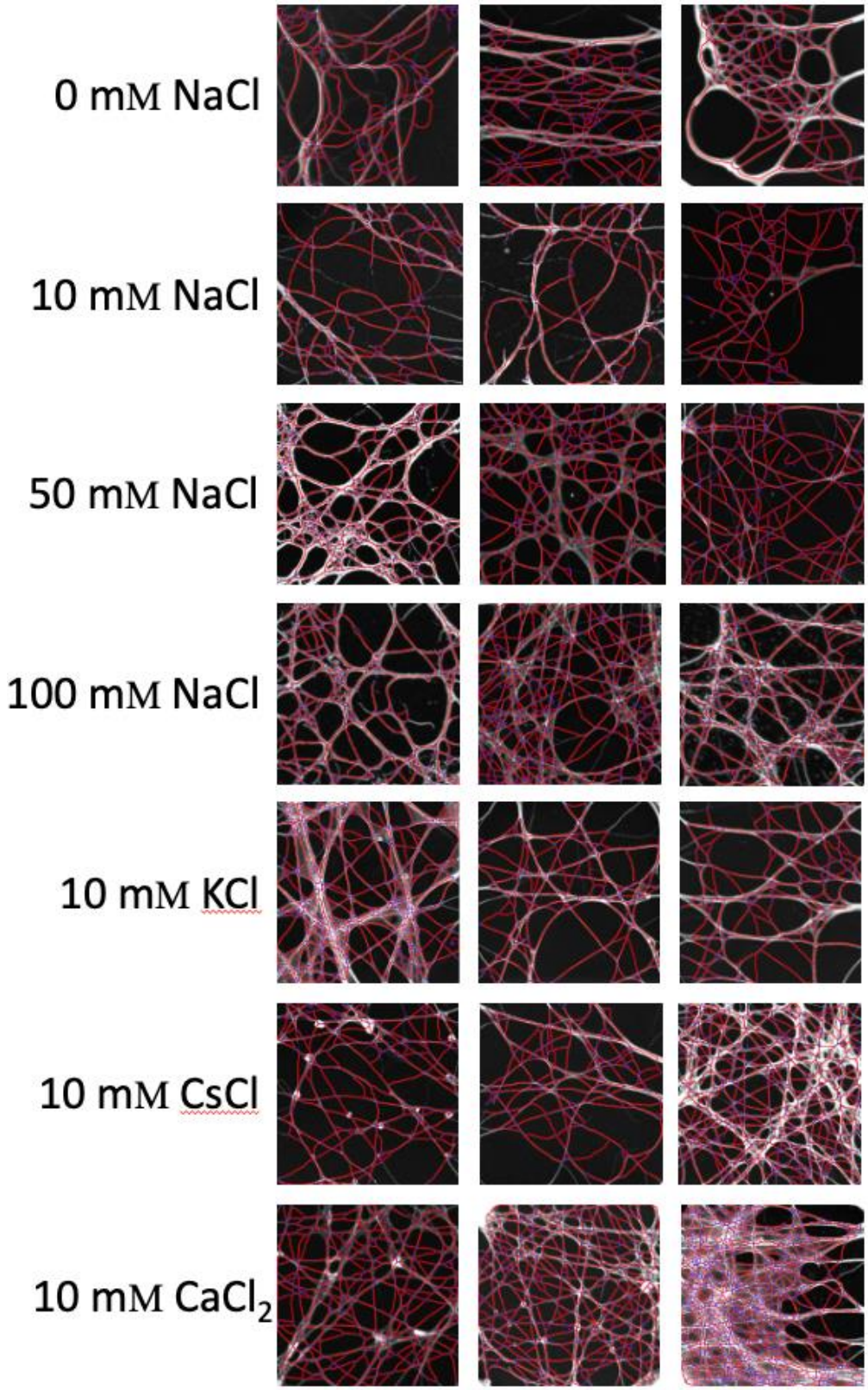


Figure S3: Additional images of PbTe NP gels with GT overlay for the 7 investigated salt conditions.

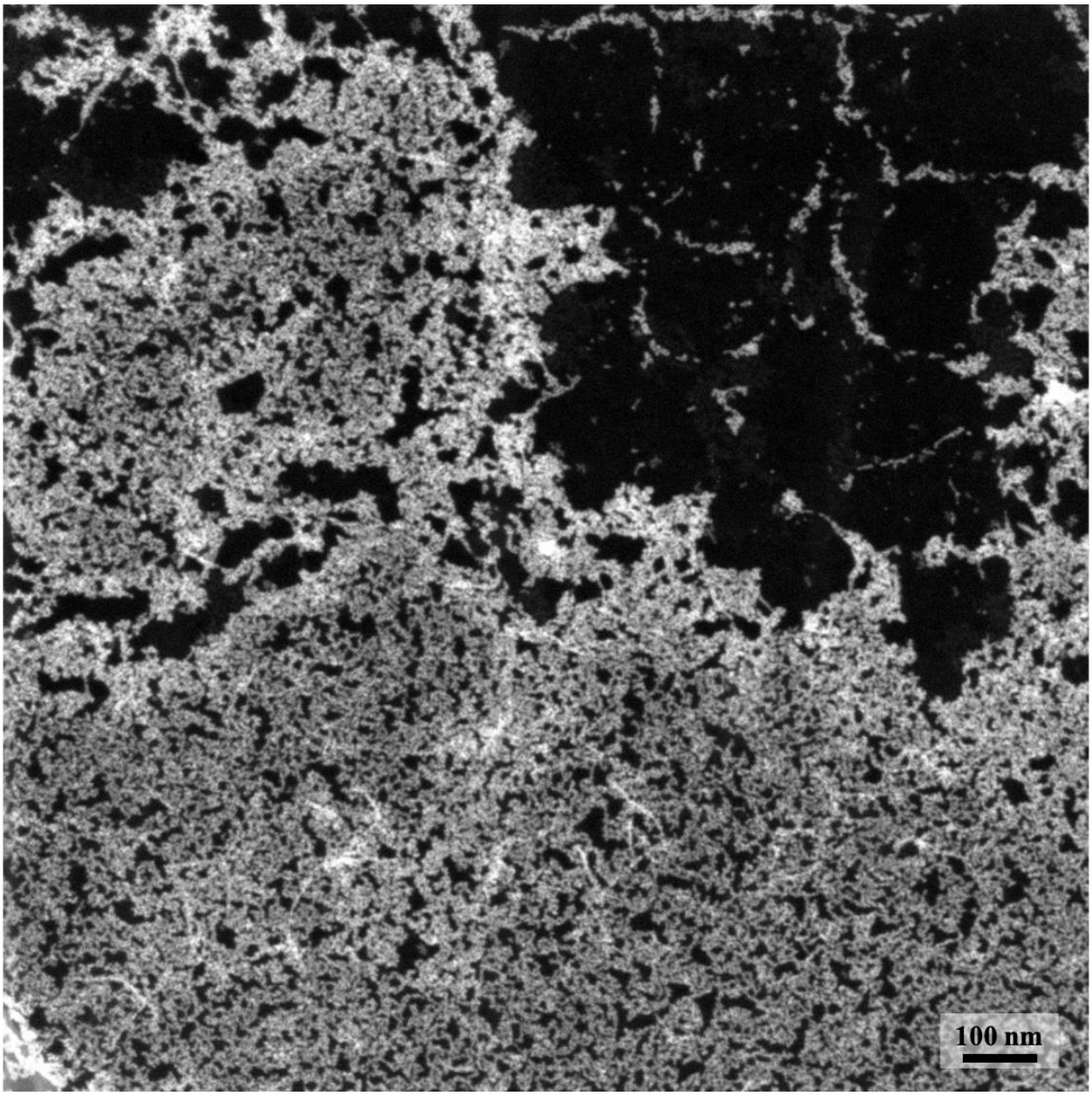


Figure S4: STEM image of PbTe NP network with an added NaCl concentration of 250 mM. At [NaCl] > ~150 mM, the electrostatic repulsive forces are sufficiently screened to cause aggregation of the NPs, collapsing the network.

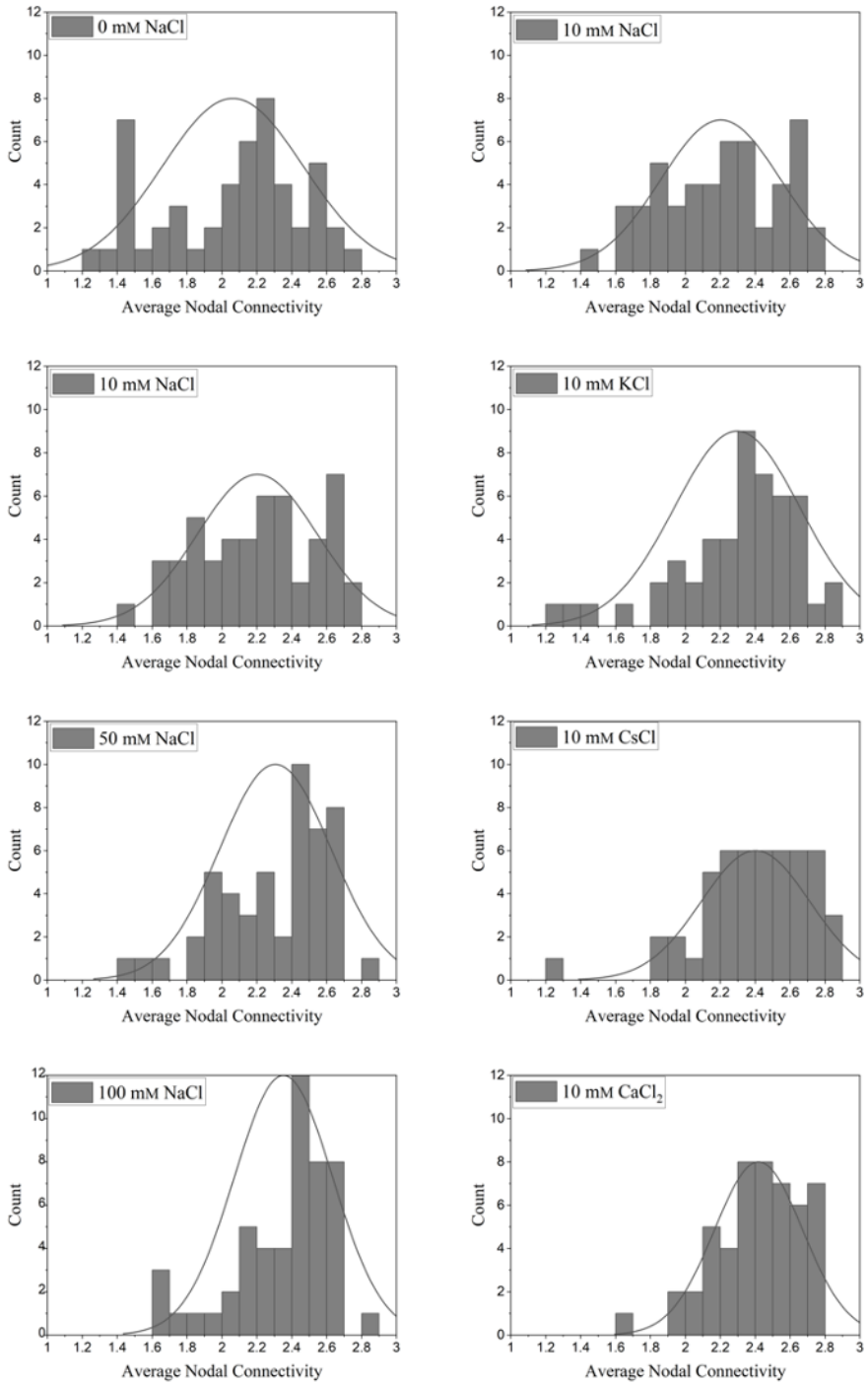


Figure S5: The histogram and distribution curve of average nodal connectivity values for each of the studied salt conditions.

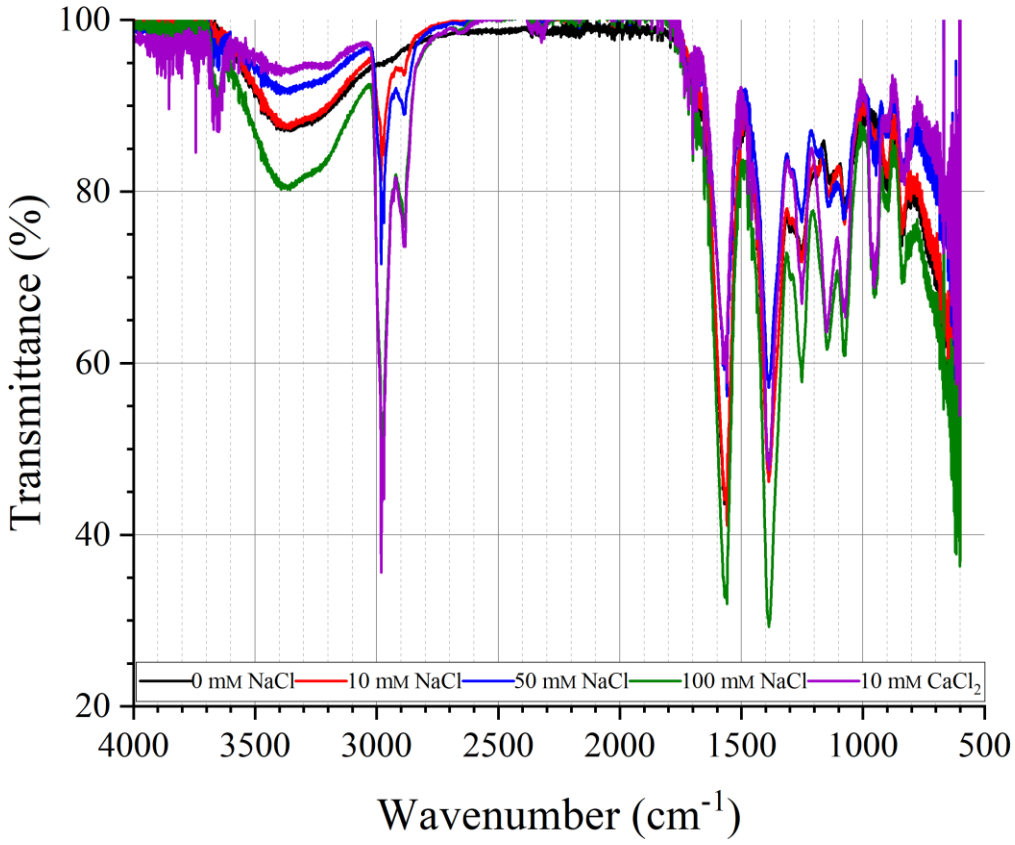


Figure S6: Full range Fourier-transform infrared spectroscopy measurement of PbTe aerogels under different salt conditions. Double peaks at 2980 and 2880 cm^{-1} correspond to the O-H stretching vibrations of carboxylic groups. The peak at 3660 cm^{-1} corresponds to O-H stretching vibrations in carboxyl groups. The broad peak from 3600-3200 cm^{-1} corresponds to water. Peaks from 1700-900 cm^{-1} correspond to various C-O, C=O, and C-H stretching, as well as O-H bending vibrations.

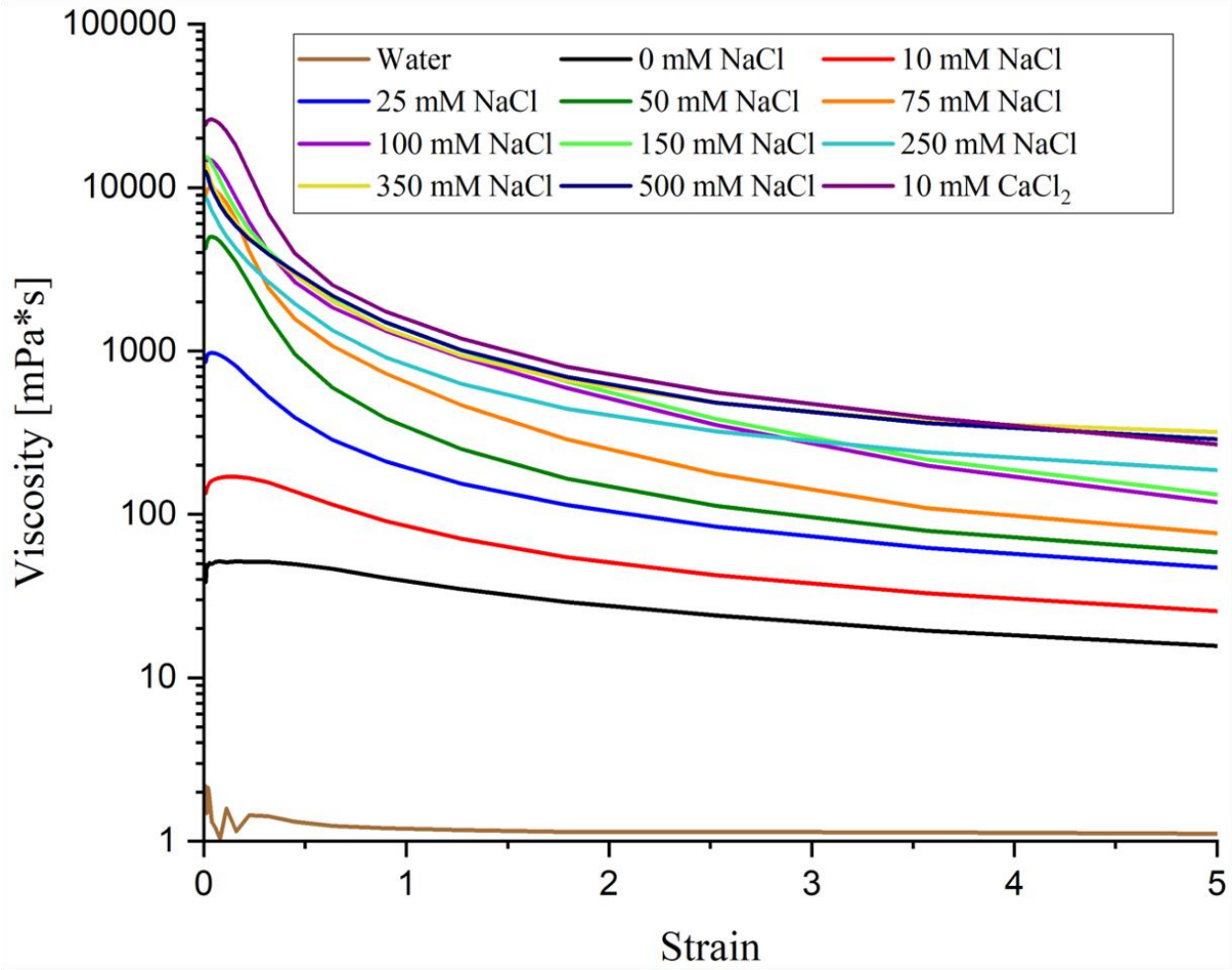


Figure S7: Viscosity of PbTe gels (and agglomerates) across a wide range of salt conditions.

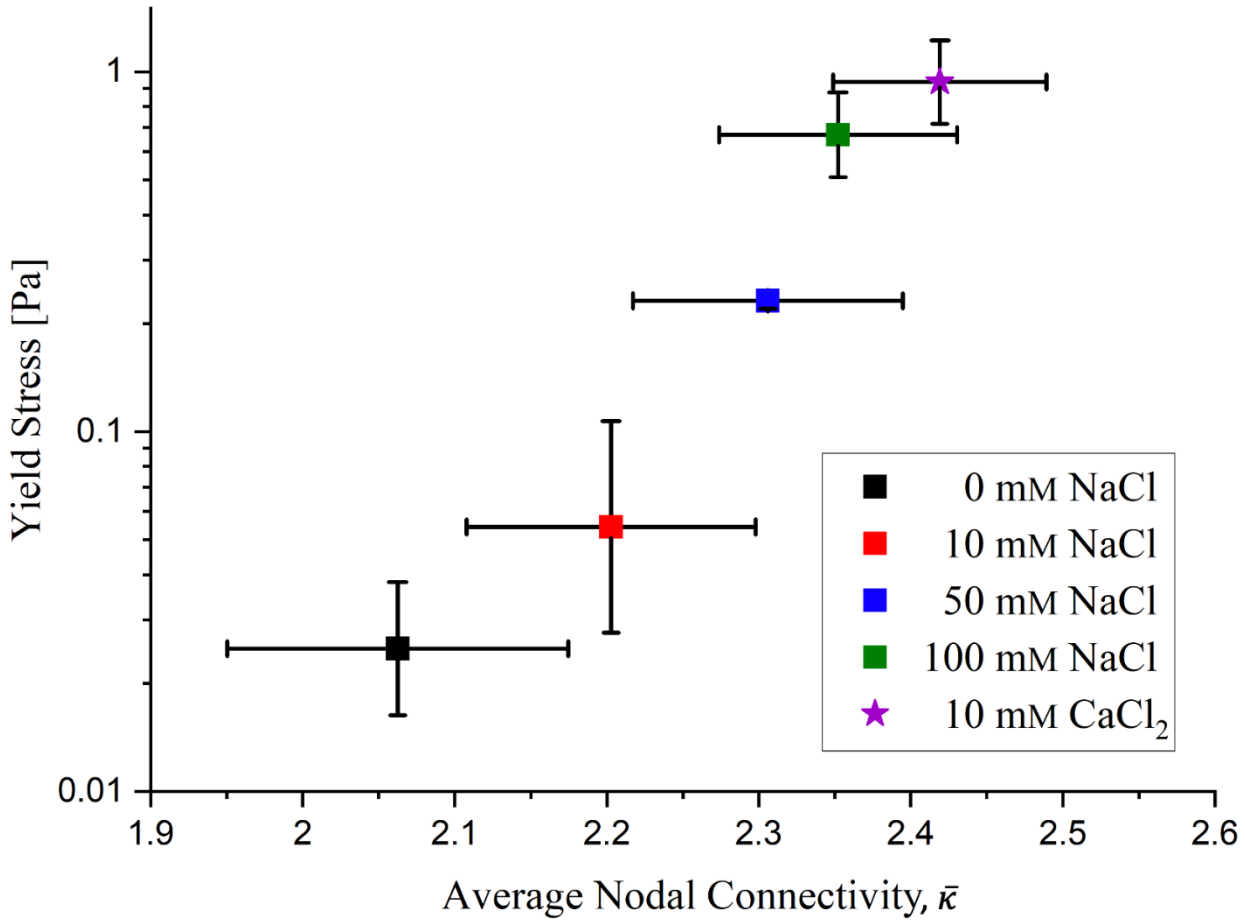


Figure S8: The yield stress of the PbTe gels compared to their computed average nodal connectivity value.

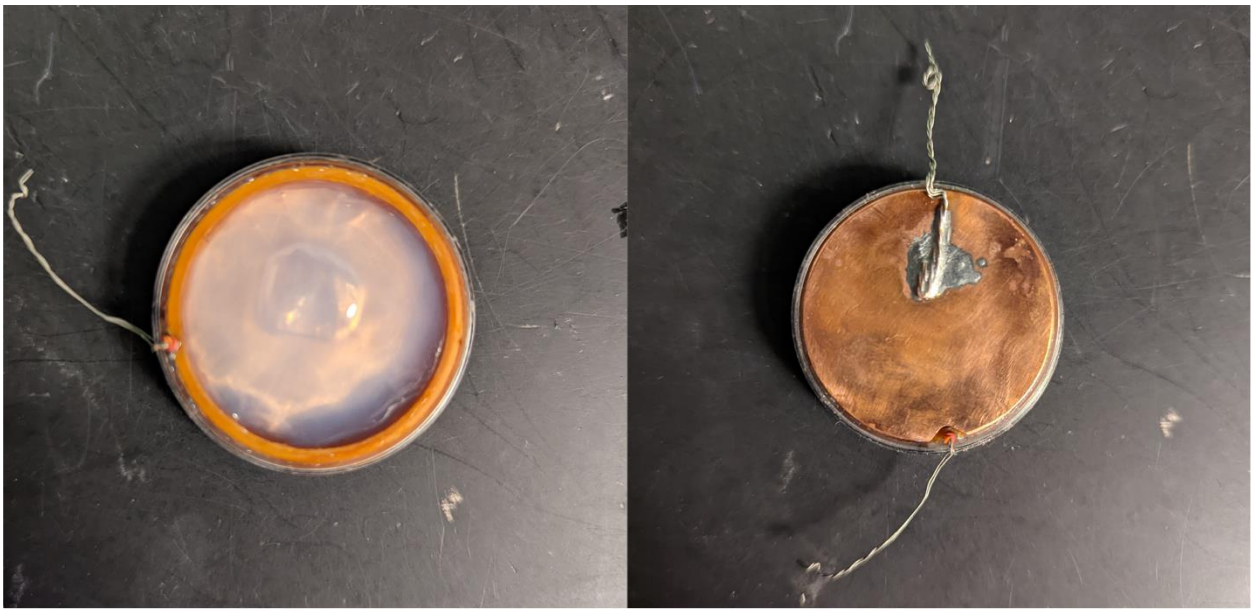


Figure S9: Photographs of the copper cell setup for measuring the *IV* characteristics of the concentrated gels. A Petri dish was fitted with a copper plate with a soldered wire on the bottom side. A plastic ring with a height of 6 mm and diameter of 32 mm was fitted into the Petri dish such that the bottom wire was aligned through a notch on the outside of the ring. Concentrated Cit-PbTe gel filled the void, and a second copper plate and wire were set on top.

References

[1] S. Ganguly, S. L. Brock, *J. Mater. Chem.* **2011**, *21*, 8800.
[2] I. U. Arachchige, S. L. Brock, *J. Am. Chem. Soc.* **2006**, *128*, 7964.
[3] A.-K. Herrmann, P. Formanek, L. Borchardt, M. Klose, L. Giebeler, J. Eckert, S. Kaskel, N. Gaponik, A. Eychmüller, *Chem. Mater.* **2014**, *26*, 1074.
[4] A. Freytag, S. Sánchez- Paradinas, S. Naskar, N. Wendt, M. Colombo, G. Pugliese, J. Poppe, C. Demirci, I. Kretschmer, D. W. Bahnemann, *Angew. Chemie Int. Ed.* **2016**, *55*, 1200.
[5] T. F. Baumann, S. O. Kucheyev, A. E. Gash, J. H. Satcher Jr, *Adv. Mater.* **2005**, *17*, 1546.