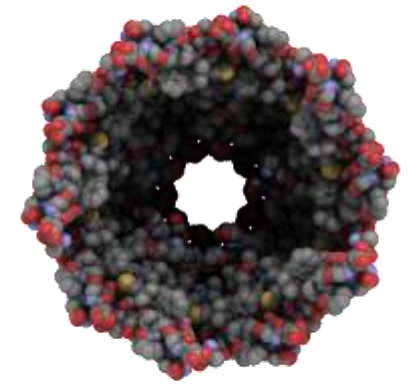
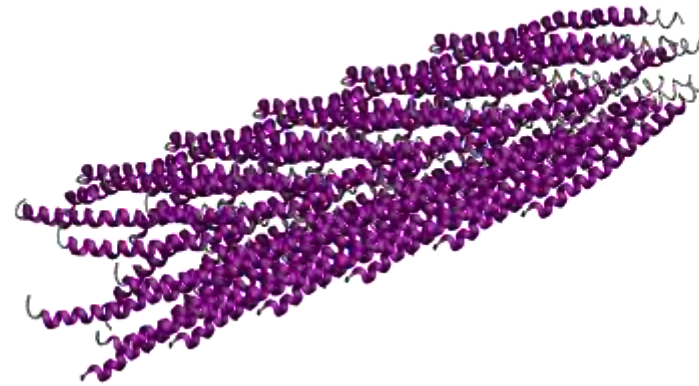
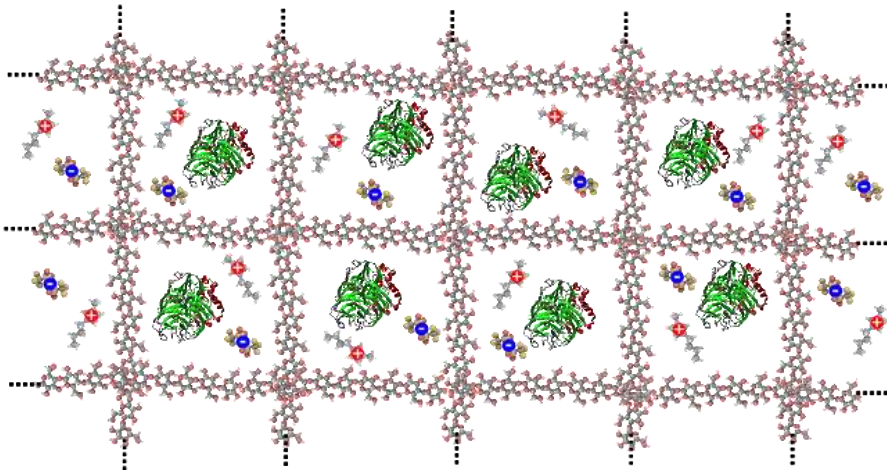



Expanding the design space of gel materials with ionic liquids and protein biofluids



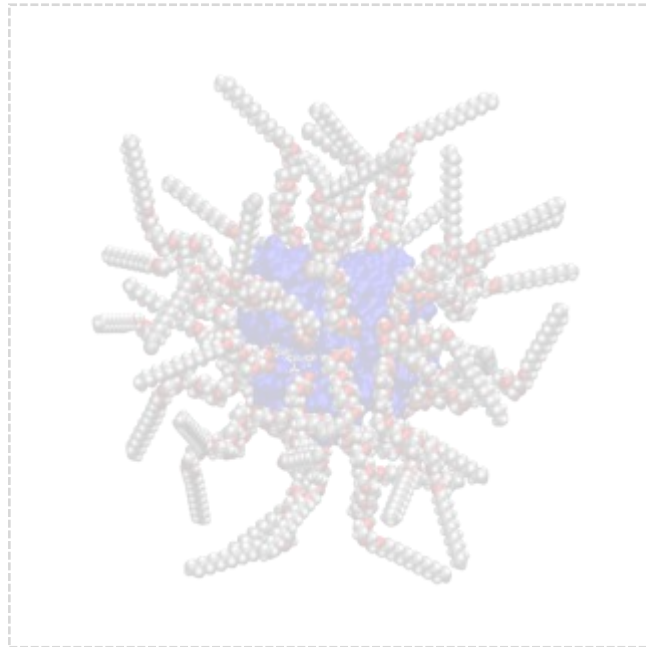
Dr. Alex P. S. Brogan
Department of Chemistry
 @apsbrogan

KING'S
College
LONDON

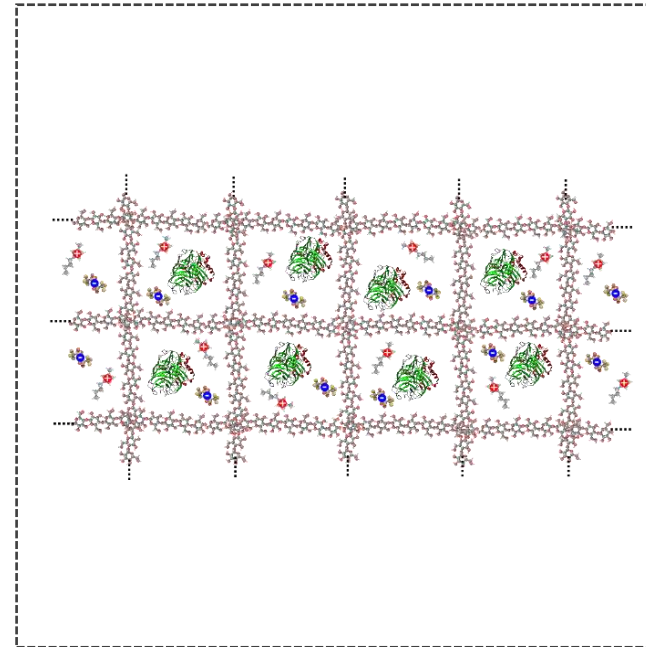
12th June 2021
MC15 – Dublin – Online
alexbrogan.co.uk/mc15

Biomaterials in the Brogan Group

Solvent-free Liquid
Proteins

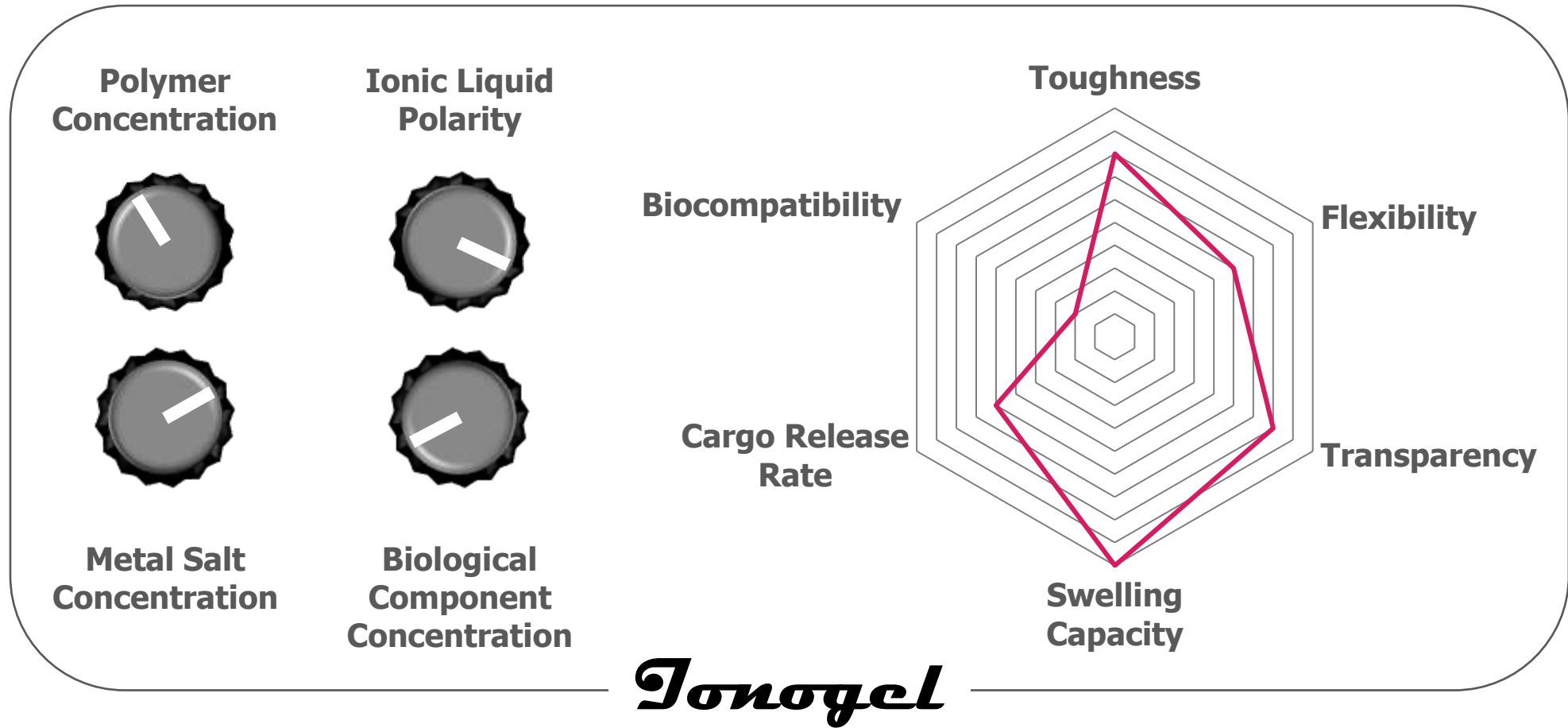


Ionogels



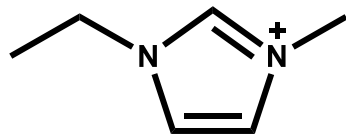
**Ionic liquid based soft materials for
biointerfacing**

Ionogels as Modular Materials



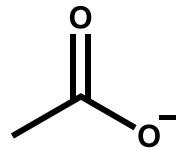
Ionic Liquids in Materials Design

Cation

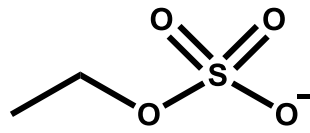


[emim]⁺

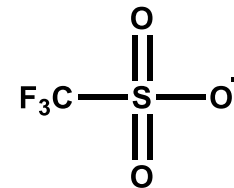
Anions



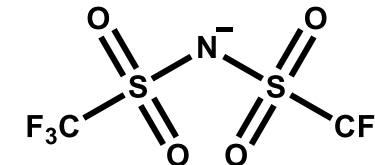
[OAc]⁻



[EtSO₄]⁻



[OTf]⁻



[NTf₂]⁻



- Ionic liquids are organic solvents with highly tuneable properties.
- Can solubilize and process otherwise recalcitrant polymers.
- High thermal stability, broad electrochemical window, and negligible vapour pressure.

→ **Relatively untapped potential in soft material design.**

Ionogel

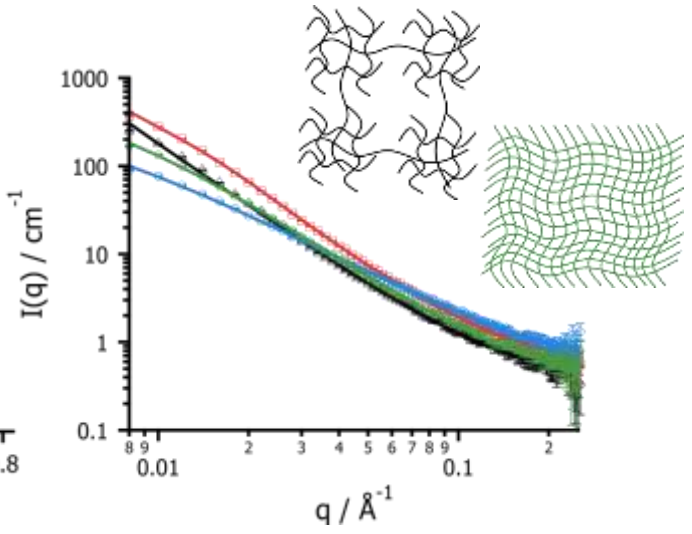
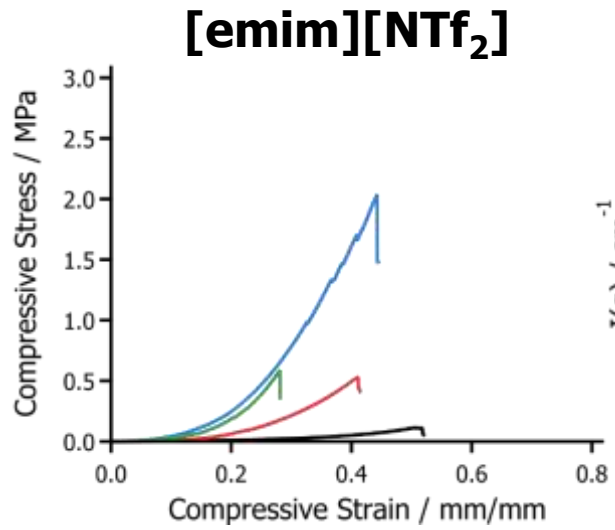
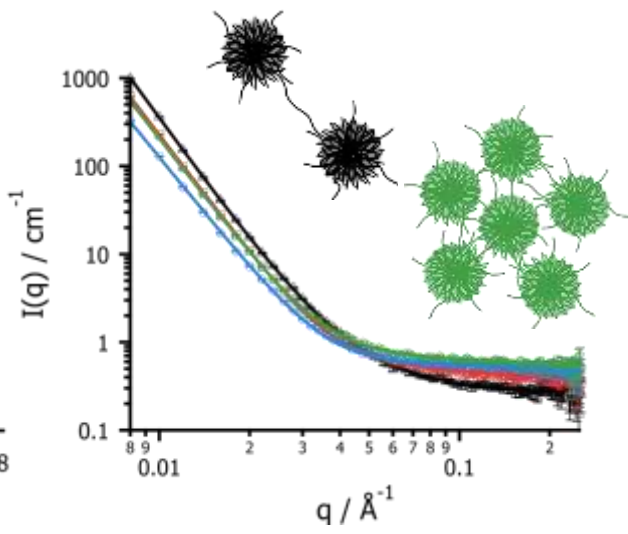
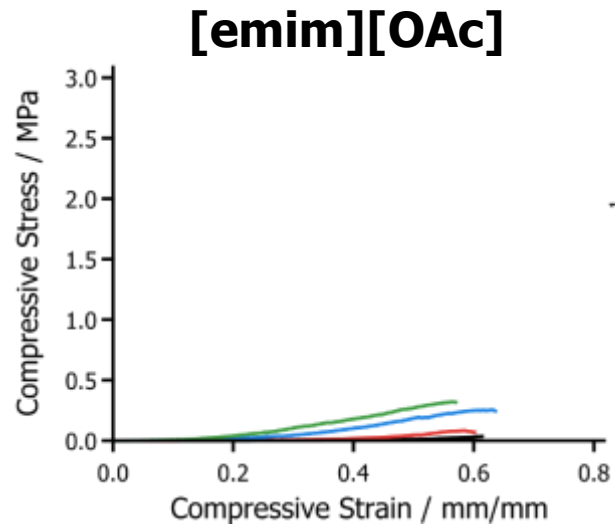
Hydrogel



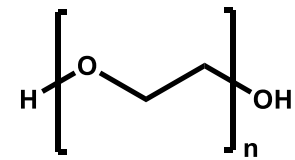
24 h



Ionogel Structure Property Relationship

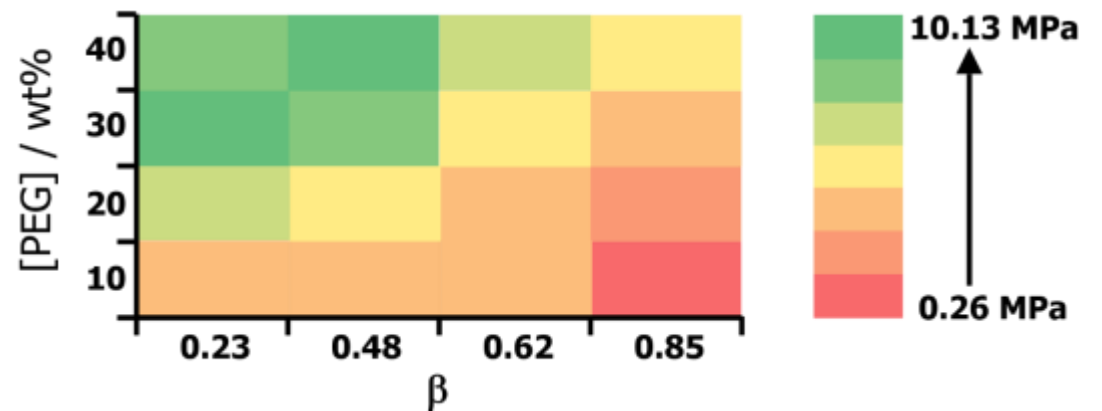


Poly(ethylene glycol) [PEG]



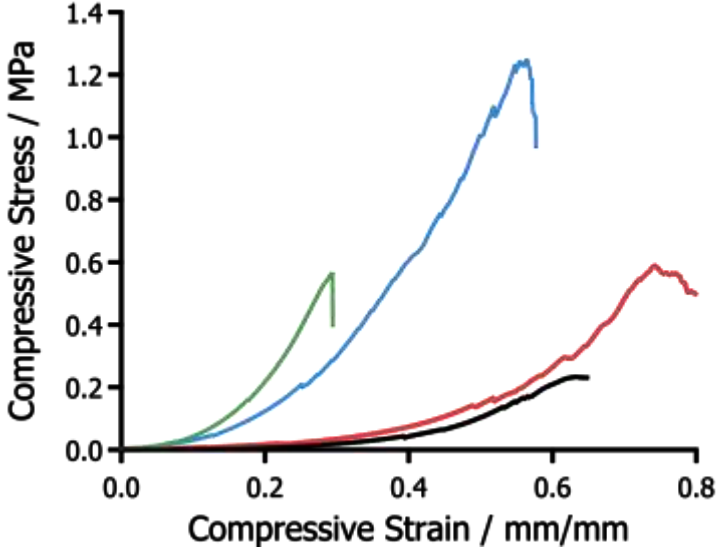
10 % 20 % 30 % 40 %

- Decreasing polarity, increasing mechanical strength.
- Lower polarity, better solvent for polymer.
- Polymer rich domains in poor solvents, to rigid networks in good solvents.

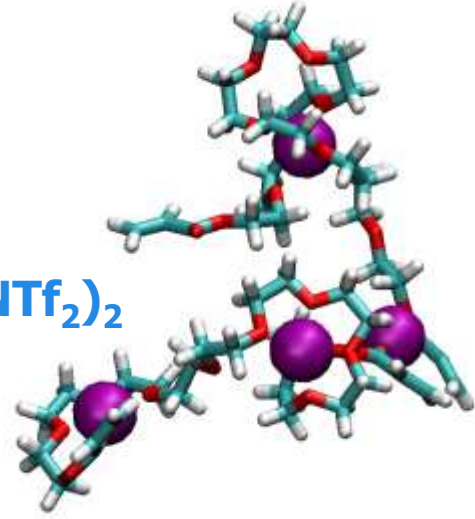


Metal Ions for Greater Control

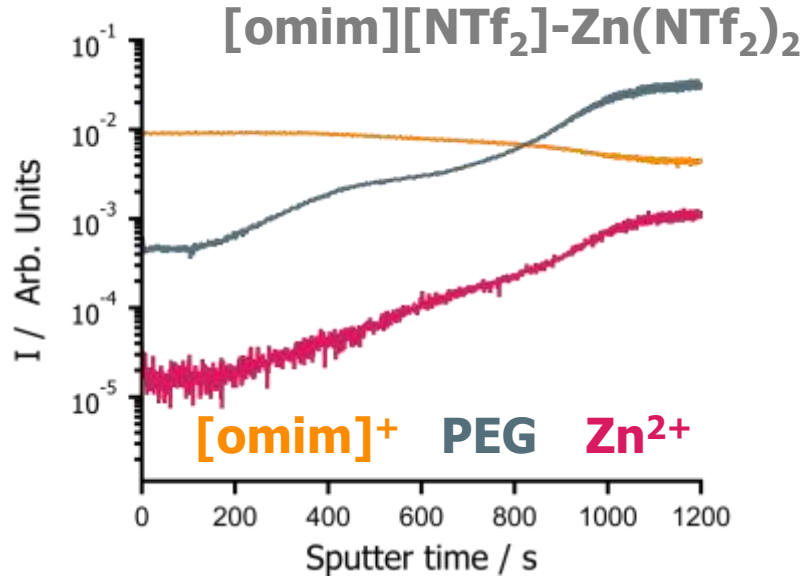
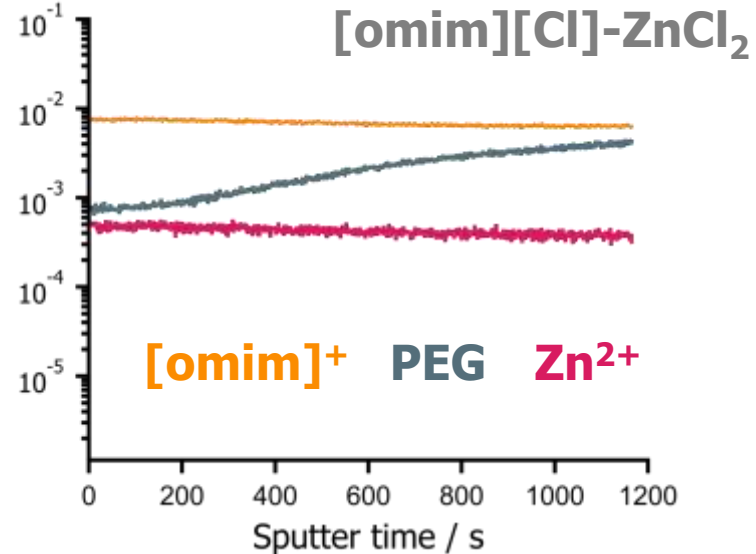
[PEG] 30 wt% : [omim][X]-ZnX₂(33 mol%)



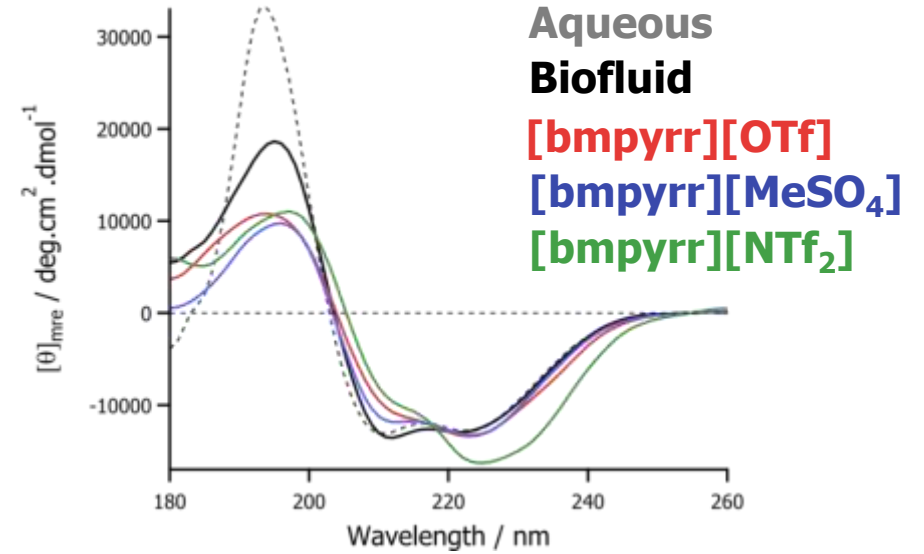
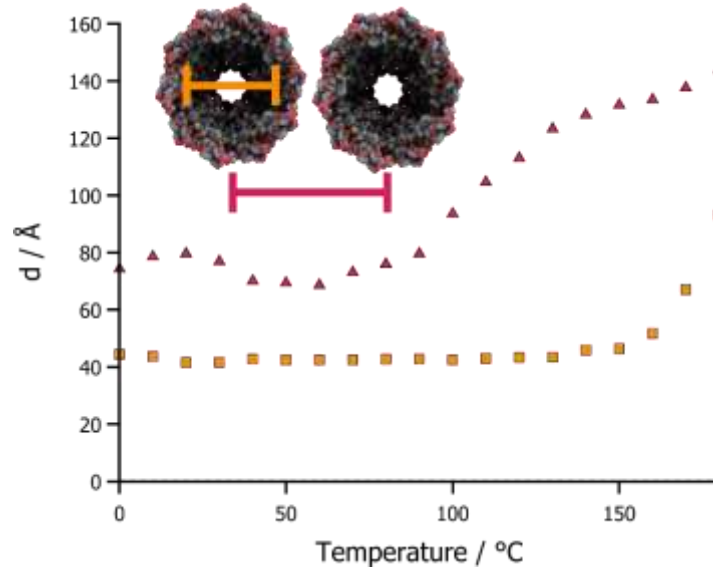
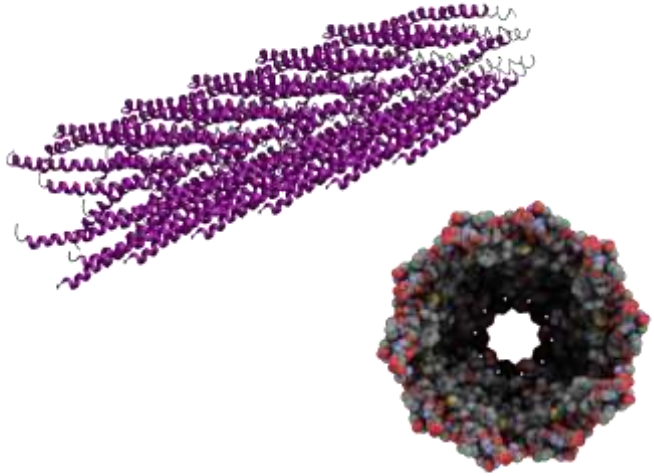
[omim][Cl]
[omim][Cl]-ZnCl₂
[omim][NTf₂]
[omim][NTf₂]-Zn(NTf₂)₂



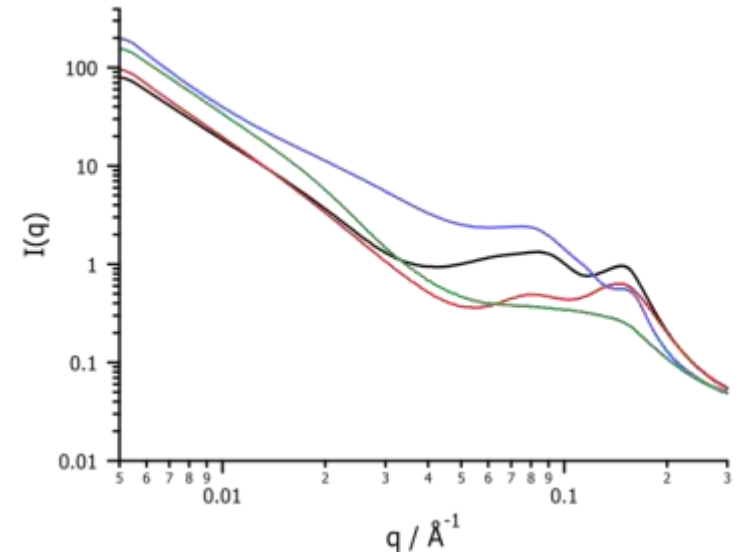
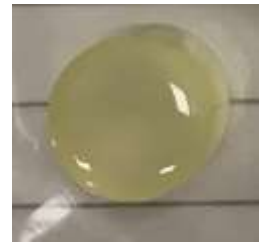
- Zn used as a model additive as ionic liquid speciation is well understood.
- Slight increases in mechanical strength of polar ionogels.
- Significant increase in flexibility/durability of hydrophobic ionogels.
- Zn coordinates to most polar component in ionogel.



Filamentous Viruses as Functional Scaffolds for Ionogels

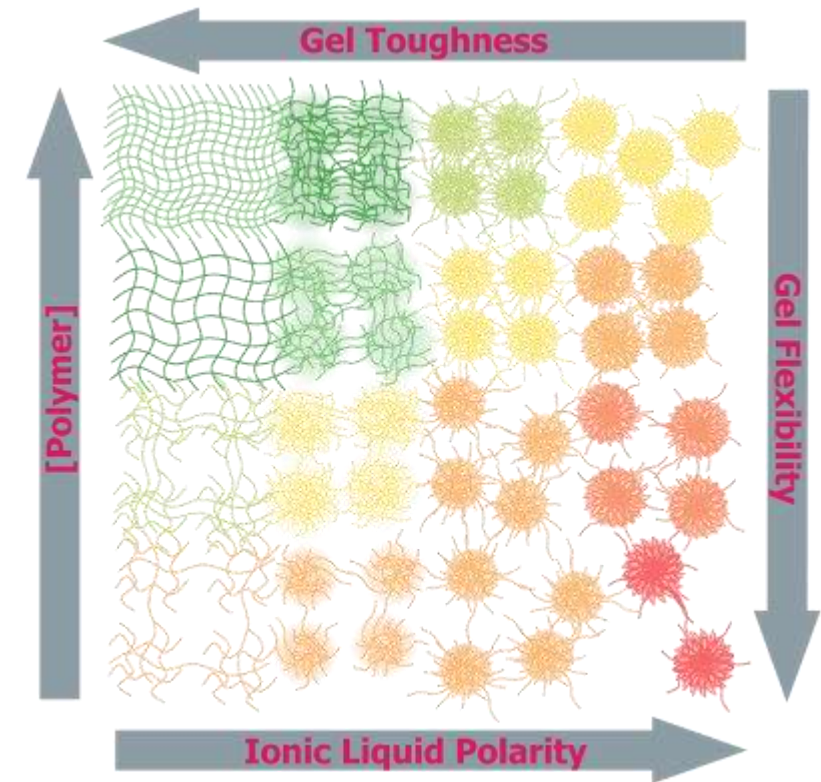


- M13 filamentous bacteriophage – 10 x 900 nm
- Global architecture of M13 maintained up to 150 °C in solvent-free biofluid.
- Structure maintained in ionic liquids.
- Ionogels with phage incorporated can be made.



Conclusions

- Exciting new material with limited research on bio-interfacing.
- Ionogel mechanical properties dictated by ionic liquid anion as well as polymer concentration.
- Solvent-polymer solubility matching can provide additional level of tuneability for gel materials.
- Metal ions can provide additional level of control.
- M13 ionogels as platform for functional soft materials.
- Ionogels have great potential for designing new biomaterials.



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