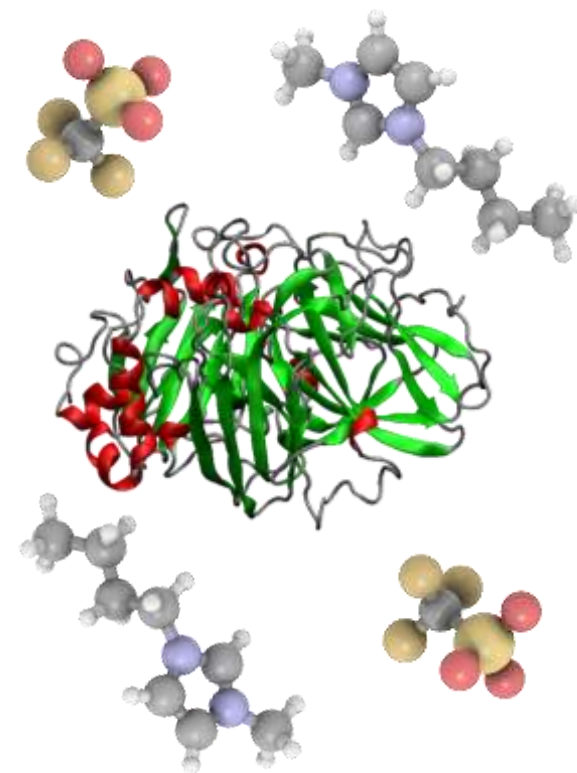
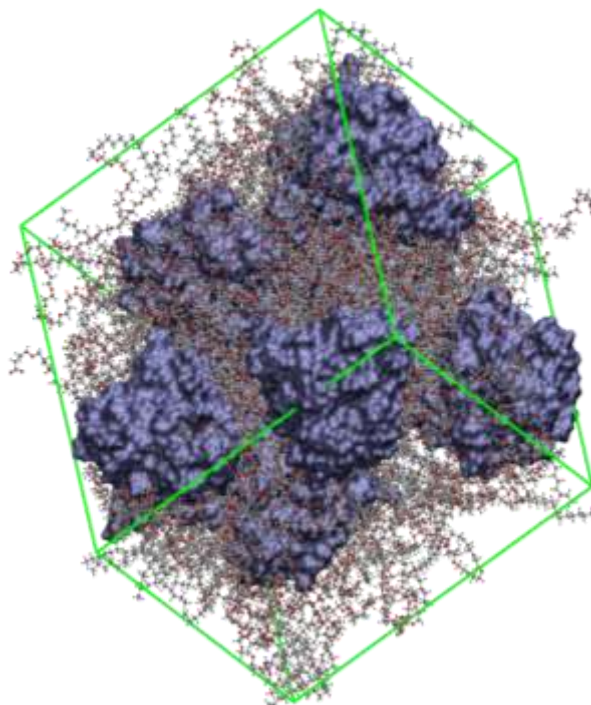
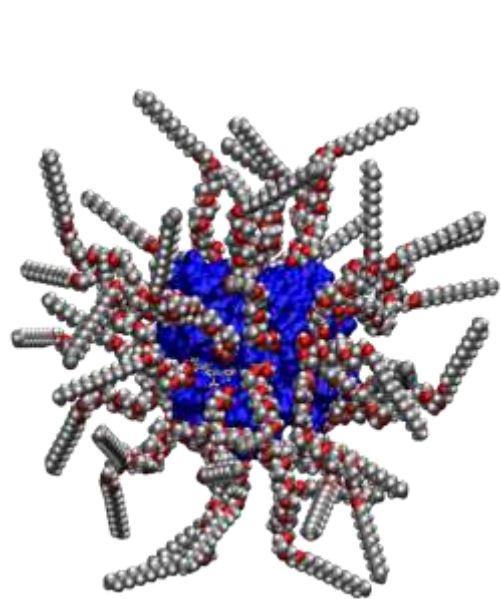


Solvent-free enzyme biofluids for anhydrous biocatalysis



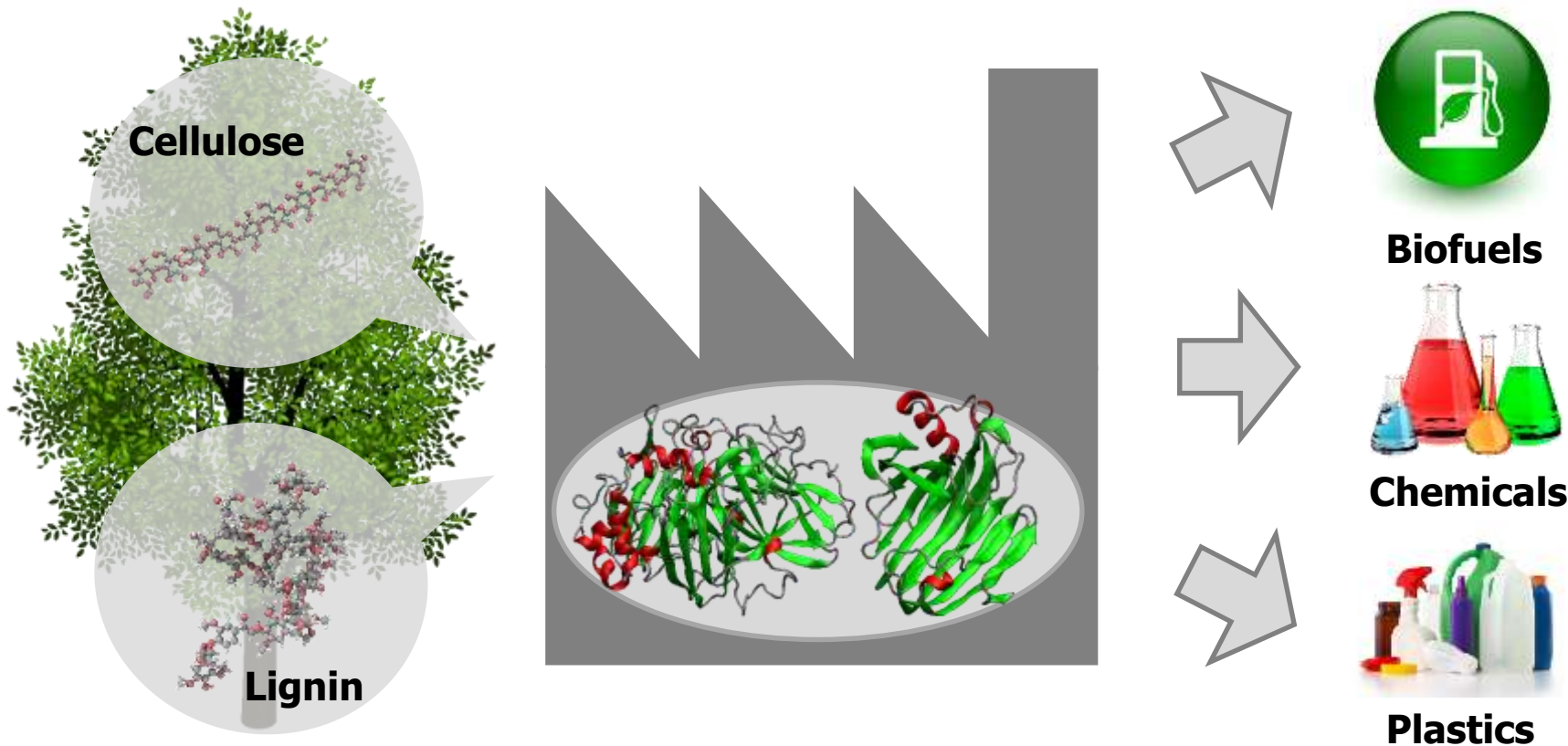
Dr. Alex P. S. Brogan

**Imperial College
London**

10th January 2018

RSC Biomaterials Chemistry Group Annual Meeting

alexbrogan.co.uk/biomaterials



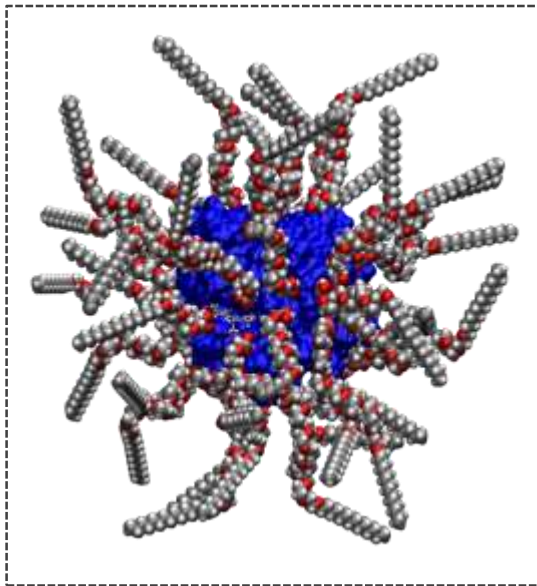
- **Ionic liquids** are a promising reaction media for industry.

→ **Biocatalysis in ionic liquids**

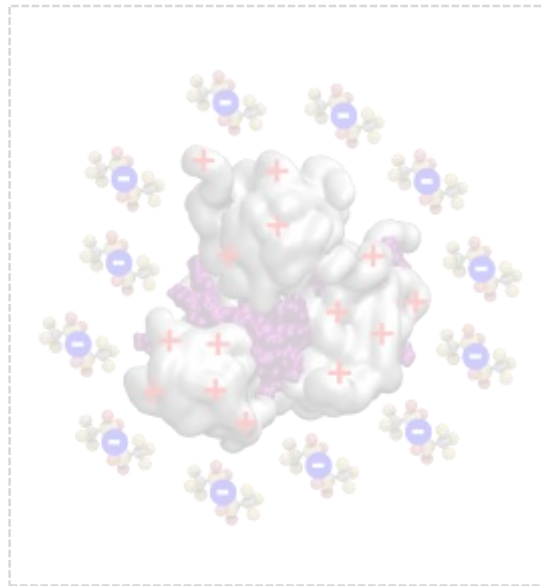
- **Enzymes** can catalyse many different industrial reactions.

- Enzymes **insoluble** and **inactive** in common ionic liquids...

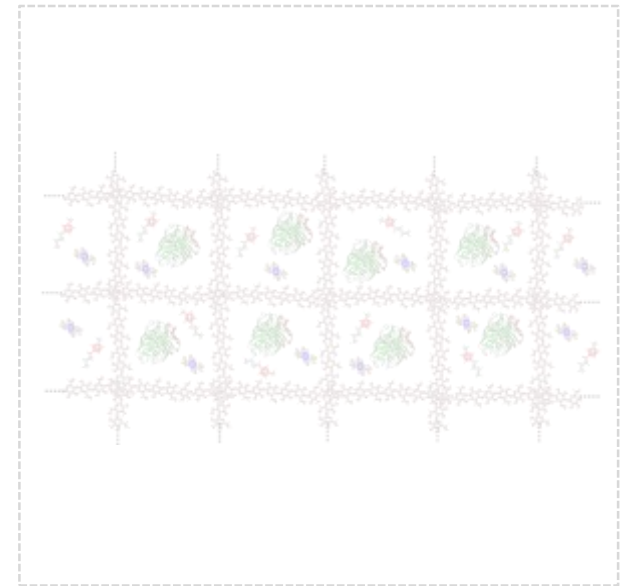
Solvent-free Enzyme Biofluids



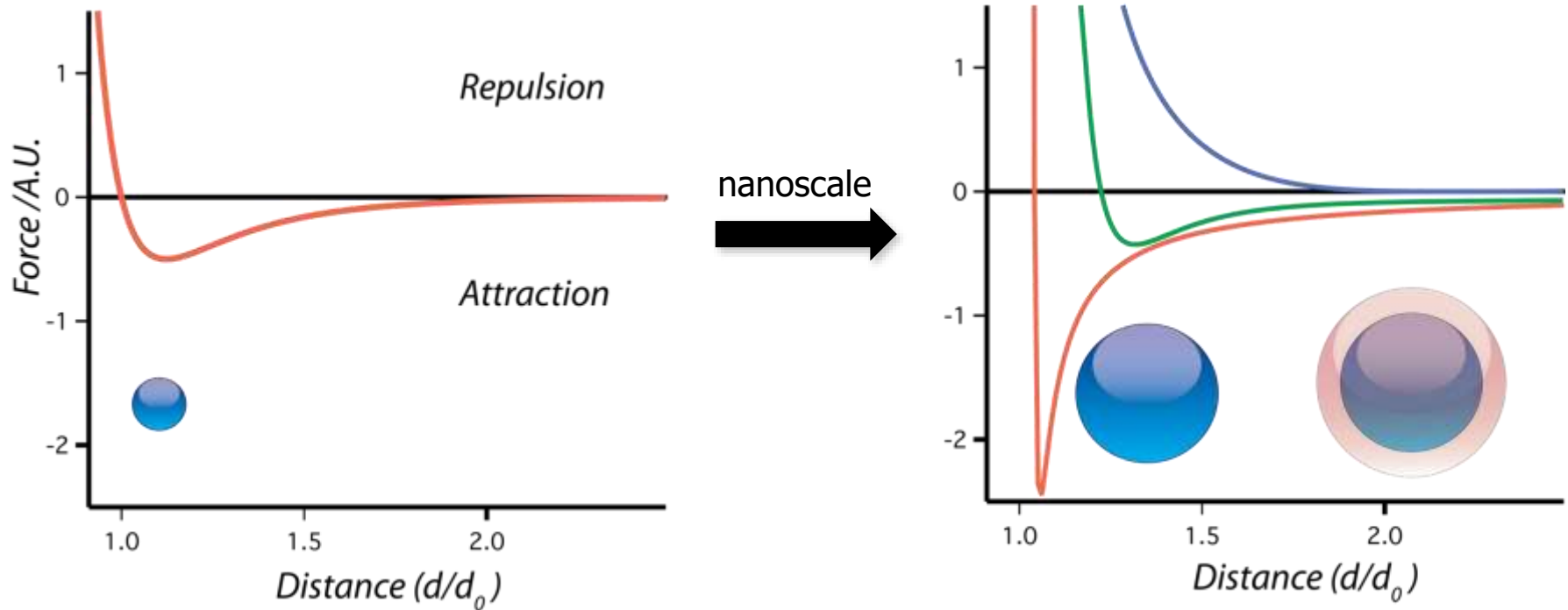
Ionic Liquid Proteins



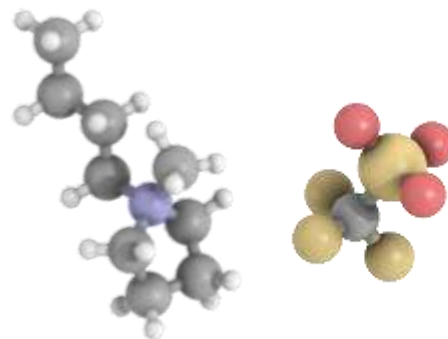
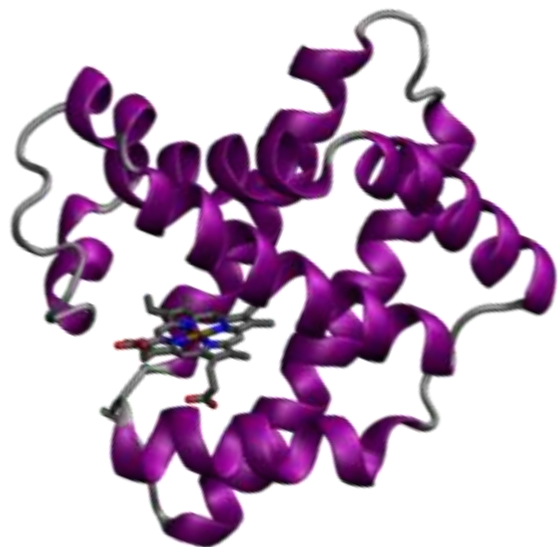
Ionogels



**Solubilize and stabilize enzymes in
ionic liquids**



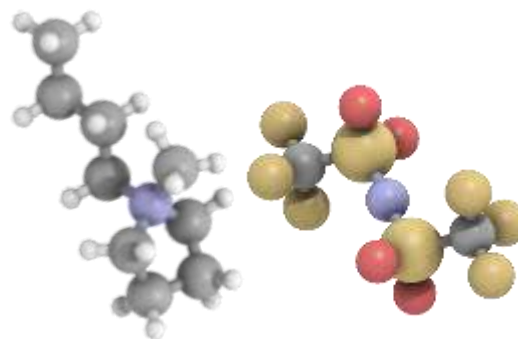
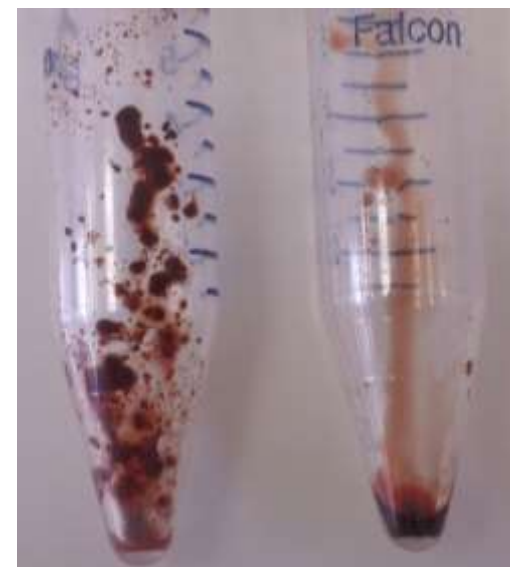
- Nanoscale objects do not have a liquid phase.
- Interparticle interactions need to be extended.



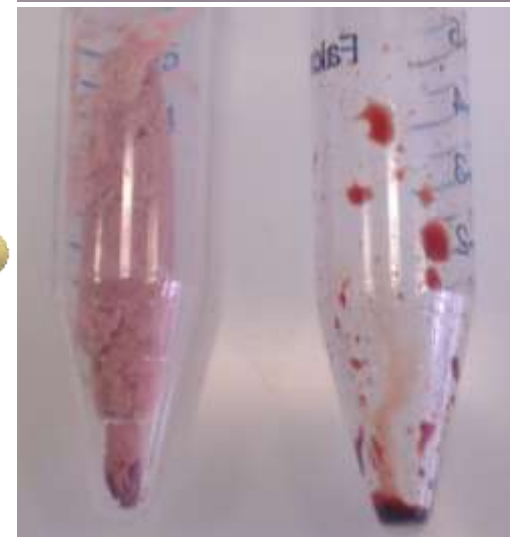
[bmpyrr][OTf]
HYDROPHILIC

Mb

[C-Mb][S]



[bmpyrr][NTf₂]
HYDROPHOBIC



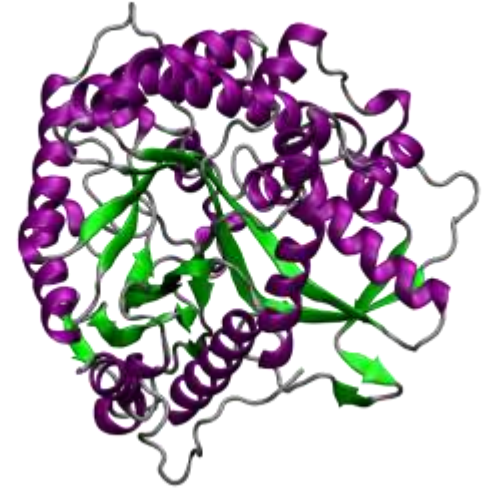
- Myoglobin as archetypal system.
- Well characterized – sensitive to environment.
- Biofluids have significant increase in IL mixing.



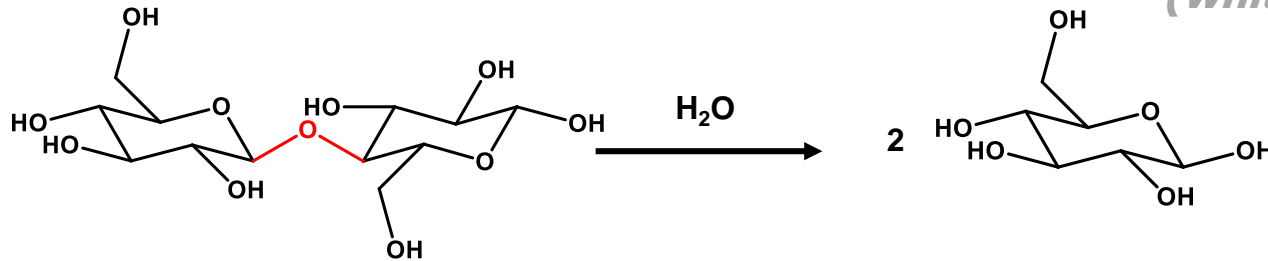
Streptomyces sp.



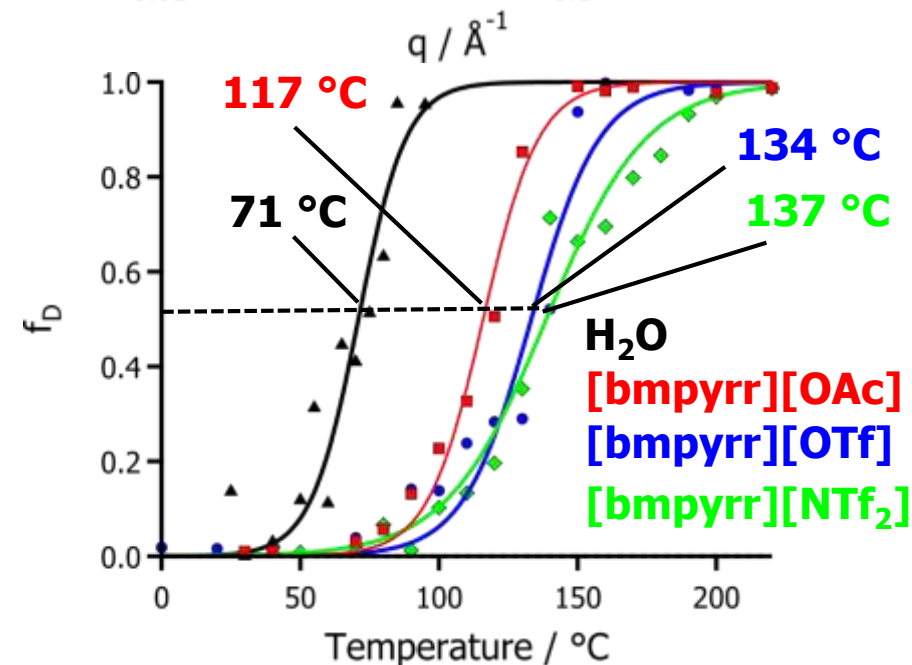
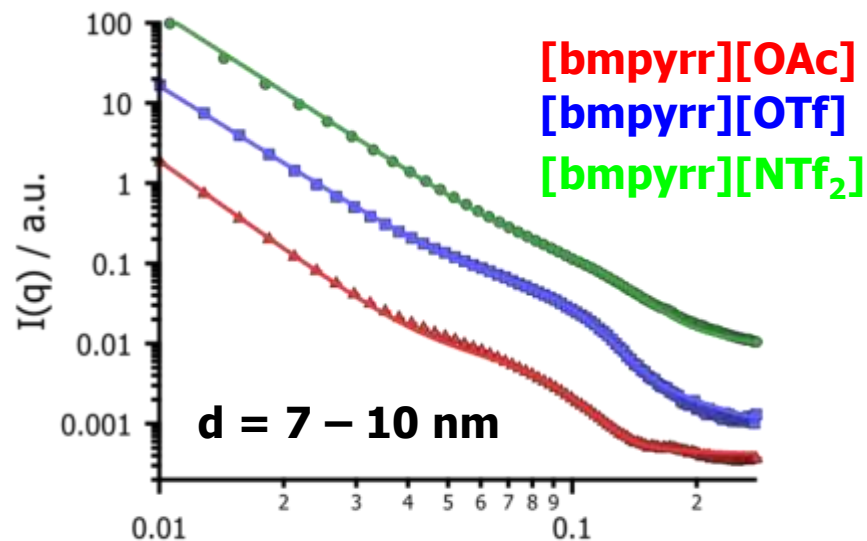
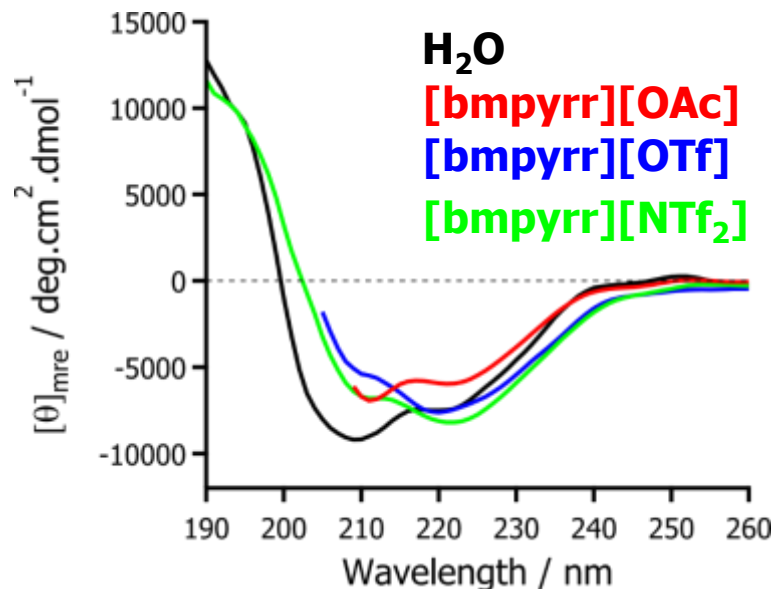
Thermotoga maritima



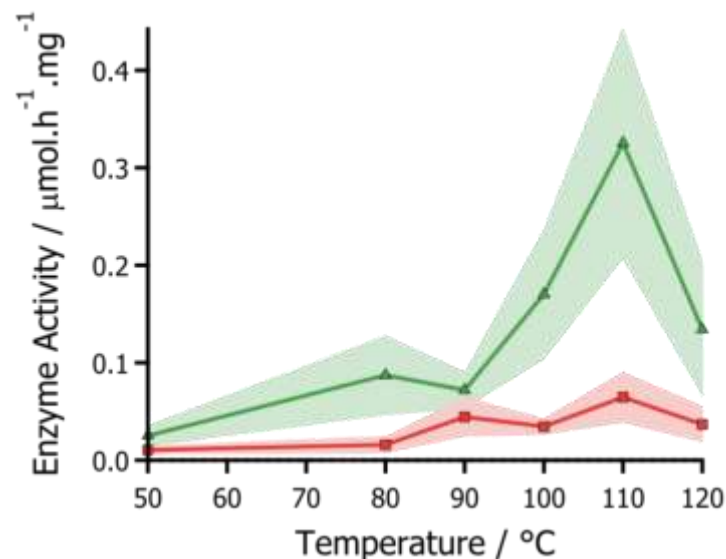
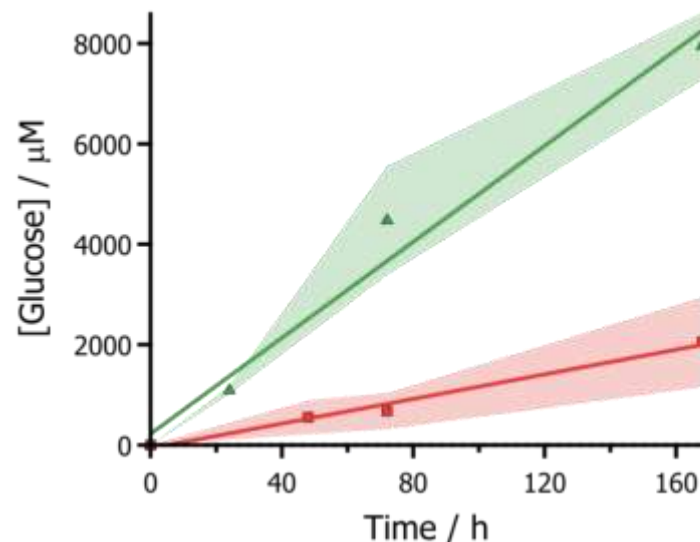
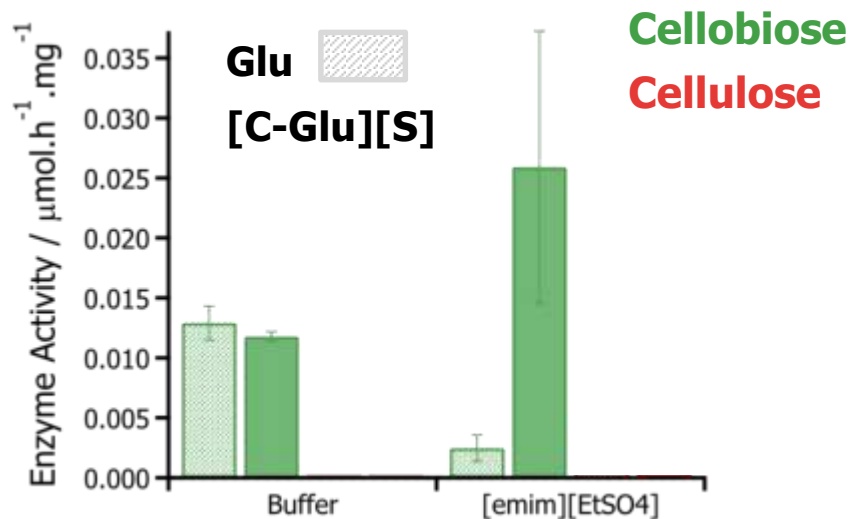
Trifolium repens
(white clover)



- Catalyses hydrolytic cleavage of α/β (1-4) linkages between sugar units.
- β -glucosidases most abundant – one of the cellulase trio of enzymes.
- Conserved structural motifs and catalytic centres (2 glutamate and 1 asparagine)

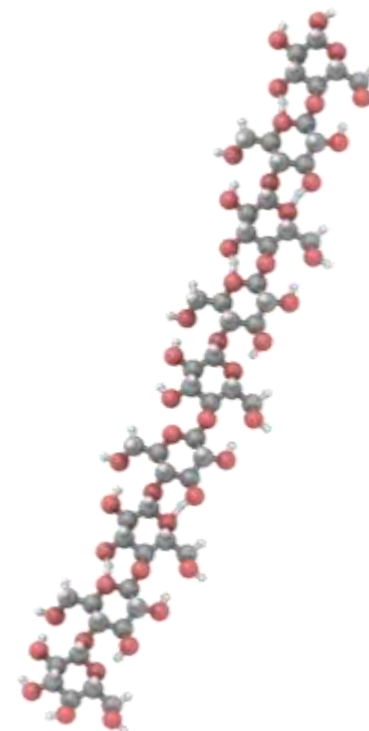
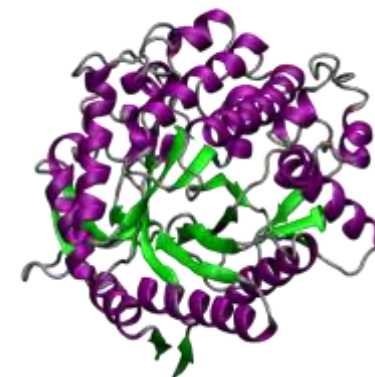


- Surface functionalization of glucosidase increases solubility in ionic liquids.
- Structure maintained (SRCD, SAXS)
- Highly stable in ionic liquids.



- Activity enhanced in ionic liquids – only for modified glucosidase.
- Reaction turns over at constant rate – zero order kinetics
- Enzyme activity increases by almost 30x at 110 $^{\circ}\text{C}$

- Robust synthesis for chemically modified proteins and enzymes.
- Good compatibility with ionic liquids.
- Protein structure highly conserved – in the absence of water.
- Thermal stability improves as compared to aqueous system.
- Enzyme activity of glucosidase enhanced in ionic liquids.
- Solvent-induced promiscuity of glucosidase towards cellulose.



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Nature Chemistry

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