

Future Vaccine Manufacturing Research Hub
Thermostable Vaccines

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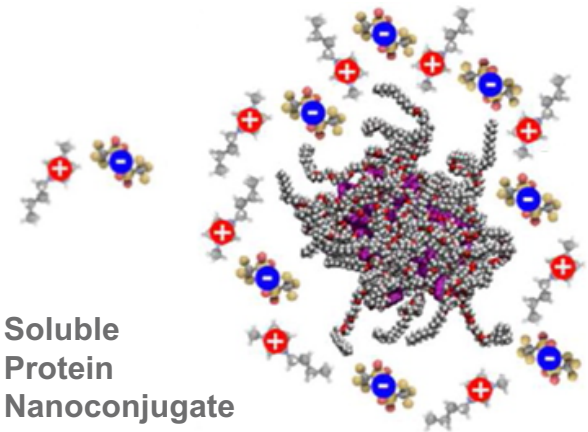
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Current and Future Strategies

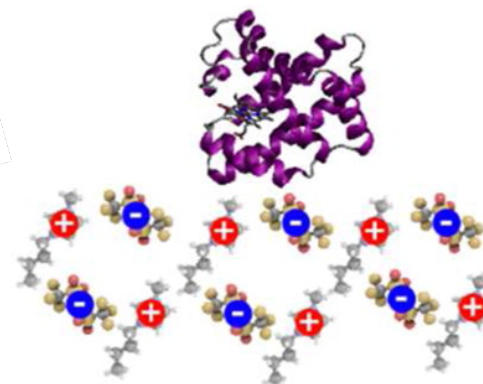
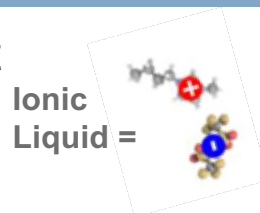
- Anti-Freezing agents: sugars or MPEGs
- Thermal Stabilisation: freeze-dried vaccines, immobilised viral particles
- **Use of biocompatible molten salts**
- **Modifying therapeutic proteins, VLPs and saRNA to be dissolved in biocompatible ionic liquids**
- Imparts higher stability to proteins (50-70 C vs native; > 100 vs aqueous)
- Demonstrated for structural proteins (stable to 180 C), enzymes (activity increased 100-1000x), antibodies (30-50x longer stability; 46% binding retained), viruses (new materials applications)
- Thermal stability increased; aggregation effectively prevented; water excluded
- Needs biocompatibility, reversibility, combination with delivery vectors
- Potential alternative to freeze drying?

Ionic Liquid =

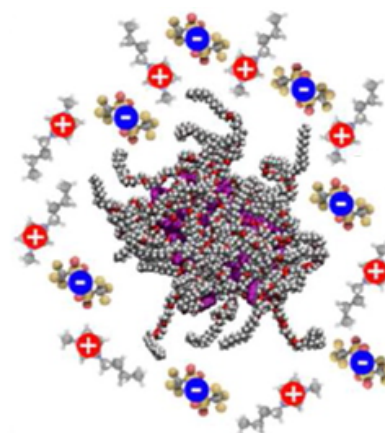
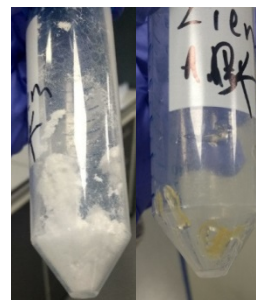


Proteins in Ionic Liquids

- Proteins are poorly soluble in neat ionic liquids
- Adding polymer-surfactant to the protein surface produces liquid proteins
- **Retains biological activity** of proteins, enzymes and viruses
- Modified myoglobin and glucosidase dissolved in hydrophilic and hydrophobic ionic liquids
- Increased protein denaturation temperature by **60° C** to **140° C** compared to aqueous solution



Insoluble
Unmodified
Protein



Modified
Soluble
Protein

Modified proteins to allow dissolution in ionic liquids^{1,2}

1. Brogan, A.P.S, and Hallett, J.P., *Journal of the American Chemical Society*, 2016
2. Brogan, A.P.S, Bui-Le, L., and Hallett, J.P., *Nature Chemistry*, 2018