Integrating semiconducting organic polymers with biological systems

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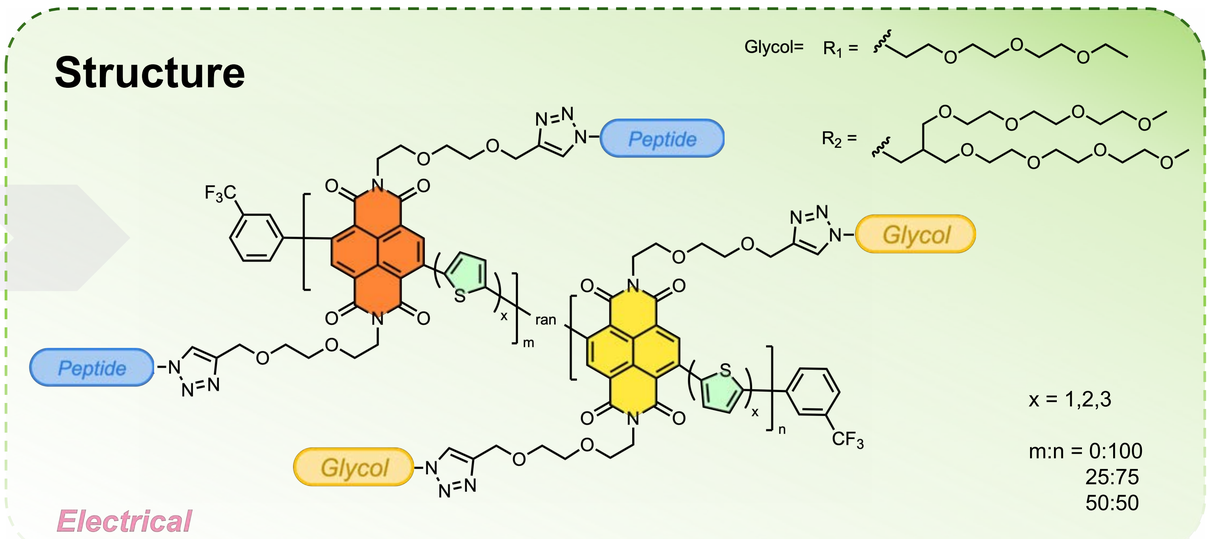
Introduction

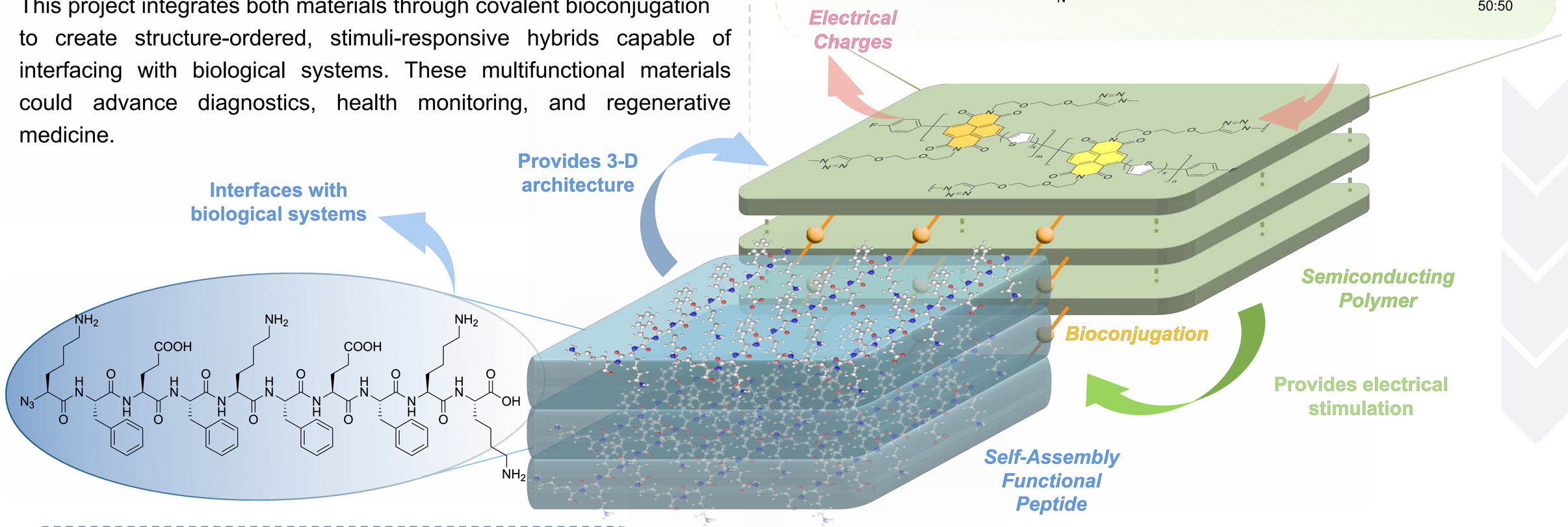
Semiconducting organic polymers

- ***Advantages****:* Good electronic performance, flexibility, tunability, and solution-processability
- ***Problems****:* Hydrophobicity, biological incompatibility, lack of control over 3-D architecture.
- ***Solutions:*** Introduce biocompatible components – peptides, which provide structural support for the polymer chains to optimise the charge-transport properties and give the option for the introduction of additional functionalities.

This project integrates both materials through covalent bioconjugation to create structure-ordered, stimuli-responsive hybrids capable of interfacing with biological systems. These multifunctional materials could advance diagnostics, health monitoring, and regenerative medicine.

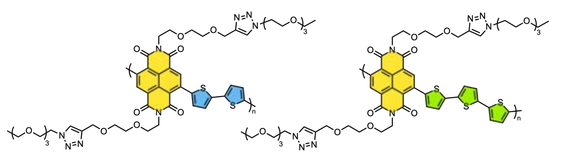
Structure

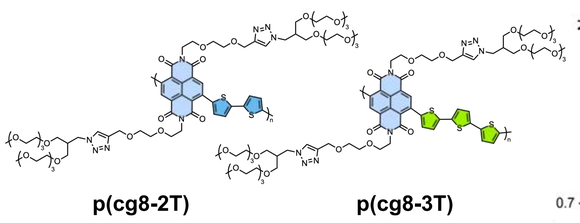




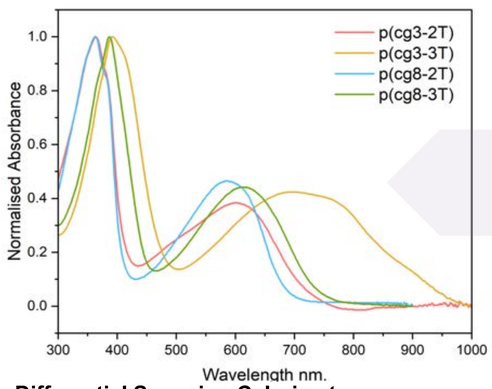
Reference Polymer Characterisation

Reference Polymer Structures

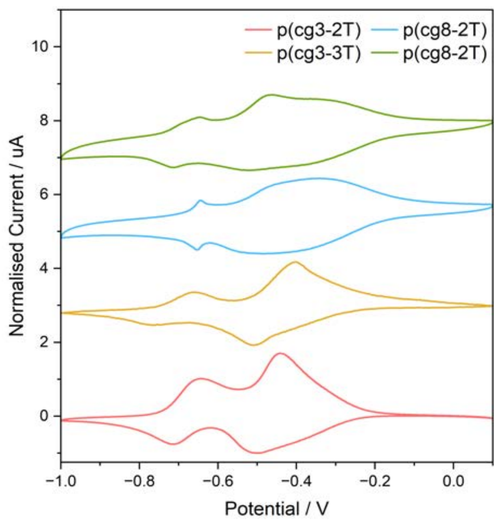




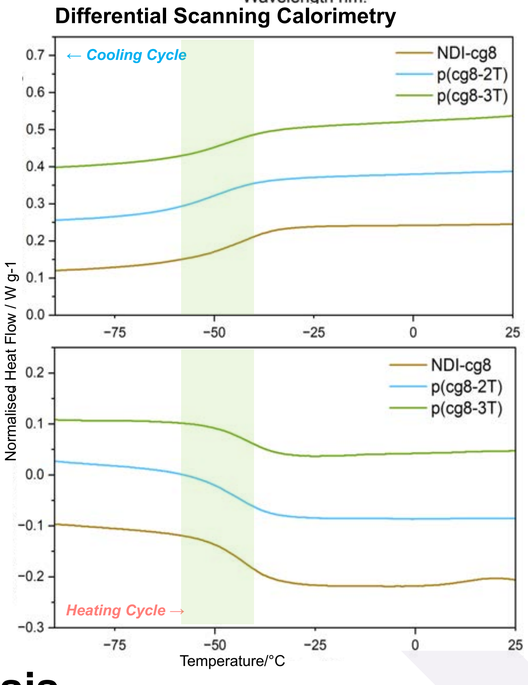
UV-Vis



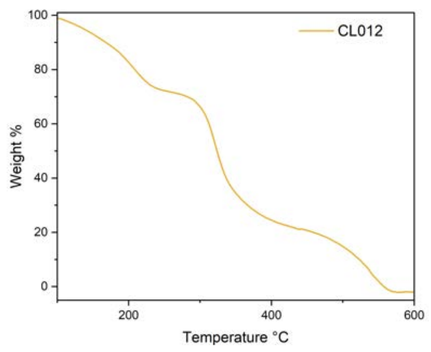
Cyclic Voltammetry



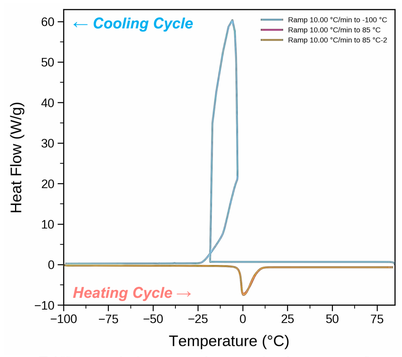
Differential Scanning Calorimetry



Peptide Thermal Analysis



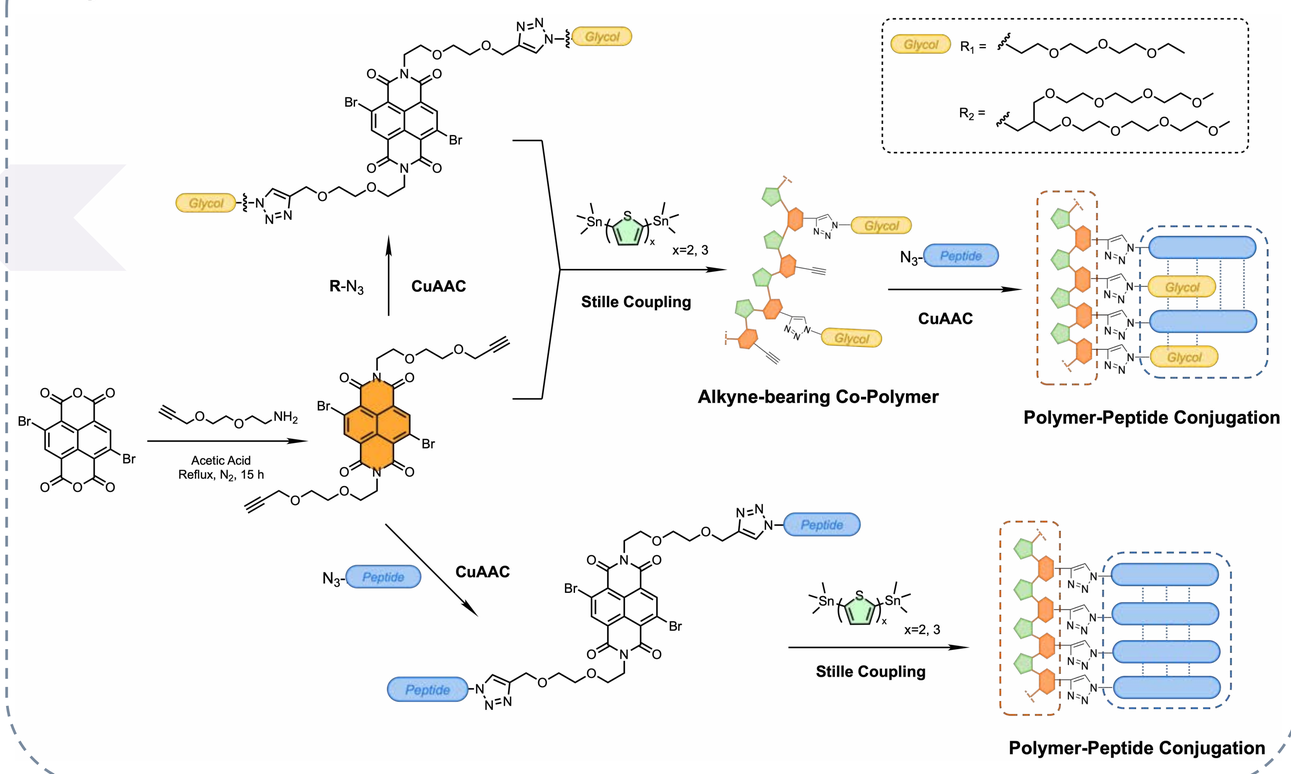
Thermogravimetric Analysis of Peptide Powder



Differential scanning calorimetry of Peptide Hydrogel



Synthesis Scheme



Conclusion

NDI-based reference polymers and copolymers were successfully synthesised and characterised, establishing a versatile synthetic platform for subsequent peptide conjugation. The use of different side-chain architectures also provides a basis for tuning polymer solubility, aggregation, and intermolecular interactions.

Ongoing peptide functionalisation will enable the influence of peptide incorporation on polymer organisation, self-assembly, and charge-transport properties to be investigated. This work therefore provides a foundation for developing peptide–polymer hybrid materials that combine the electronic properties of conjugated polymers with the structural and functional versatility of peptides, with potential applications in bioelectronics.

Reference

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2. J. K. Wychowaniec, A. M. Smith, C. Ligorio, O. O. Mykhaylyk, A. F. Miller, A. Saiani, *Biomacromolecules*, 2020, **21**, 2285-2297

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