Carbodiimide-Fueled Assembly of π-Conjugated Peptides Regulated by Electrostatic Interactions

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What was achieved?:
Peptides naturally have stimuli-adaptive structural conformations that are advantageous for endowing synthetic materials with dynamic functionalities. Here, the authors used carbodiimide (EDC) as a fuel, combined with electrostatic modulation, to instruct π-conjugated peptides to self-assemble and be responsive to thermal disassembly cues upon consumption of the assembly trigger. The study demonstrated that the carbodiimide-fueled assembly and subsequent thermally assisted disassembly can be modulated by the net charge of the peptidic monomers, suggesting an assembly mechanism that can be encoded by sequence design. The study provides insights into controlling the dynamic self-assembly of optoelectronically active biomolecules, offering a new opportunity to access a broader morphological assembly landscape while leveraging non-equilibrium states of functional peptide-based supramolecular materials towards optoelectronic device applications.

Why is it important?:
The development of a carbodiimide-based approach for the assembly of designer π-conjugated systems offers a unique opportunity to develop bioelectronic supramolecular materials with controllable formation of dynamic and stimuli-responsive structures. The ability to control the self-assembly and disassembly of peptides in response to environmental cues is crucial for the development of functional biomaterials for various applications such as drug delivery, tissue engineering, and optoelectronic devices. The findings of this study could contribute to the development of new materials with tailored properties that could lead to advancements in various fields such as biomedicine and electronics.

How did BioPACIFIC MIP enable this?
In this study, the researchers utilized BioPACIFIC MIPs SAXS to investigate the relationship between molecular design and structure in the linear π-conjugated peptides assembled through a fuel-driven mechanism. The collaboration with BioPACIFIC MIPs project scientists Philip Kohl and Youli Li played a crucial role in uncovering the structures, leading to their co-authorship in the paper.

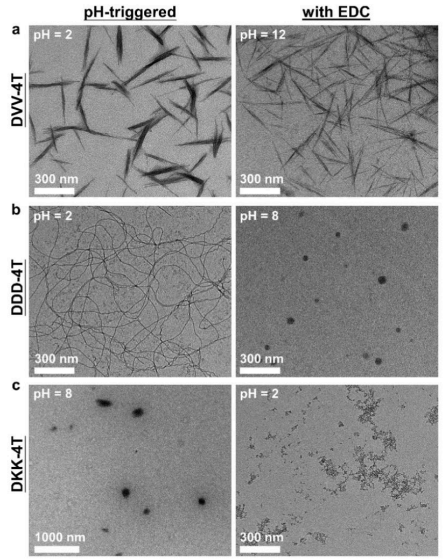

Figure 1: *A fuel-driven assembly and disassembly of semiconducting peptides show morphologies that are sequence-dependent and distinct from pH-driven assemblies*

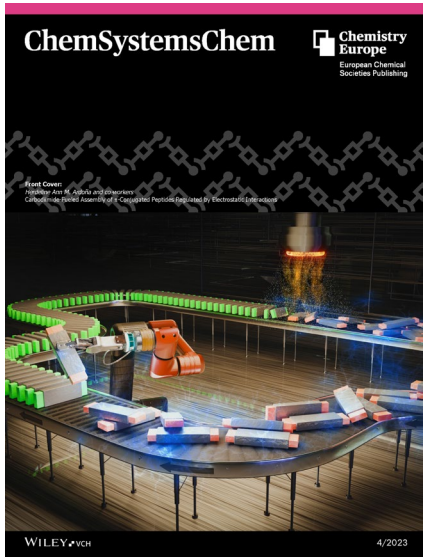

Figure 2: *Featured cover article in ChemSystemsChem Journal. Article also selected for the Systems Chemistry in the USA special collection and Chemistry Europe Editor's Choice: Spotlights*

Publication: Ze-Fan Yao, Yuyao Kuang, Philip Kohl, Youli Li, Herdeline Anne .M. Ardoña, *ChemSystemsChem 2023, e202300003*
doi:10.1002/syst.202300003