

The Pappas research group is offering the following position:

ERC-funded PhD position: Phosphate-Driven Non-Equilibrium Assemblies (PhosphoChem)

More information about our research focus: <https://pappasresearchgroup.com/>

Starting date: 01/03/2024 or earliest possible time

Project description

Phosphates and phosphate esters regulate and enable functions: from encoding genetic information and directing temporal protein functions to signaling transduction mechanisms and providing chemical energy. In particular to the energetics of life, phosphoric anhydrides (ATP, GTP) drive selective processes, by incorporating chemical information (A vs. G) in their chemical structure. Despite the multifaceted role of phosphates in biology, their use in supramolecular systems chemistry remains largely underexplored. We recently demonstrated that aminoacyl phosphate esters can be utilized for the spontaneous and selective oligomerization of peptide bonds in water,¹ where the hydrophobicity in the structure of monomers dictates the length of the oligomerization and the composition in different phases (Fig. 1).

For the project PhosphoChem, we look for a highly motivated PhD candidate for the development of peptide chemical reaction networks using aminoacyl phosphate esters. The aim of the project

is to (i) design and synthesize amino acid and peptide acyl phosphate esters using solution and solid phase methods (ii) construct dynamic systems in the presence of various nucleophiles, (ii) characterize these systems in terms of composition, nanoscale architecture and supramolecular interactions and (iv) investigate whether environmental changes can lead to different pathways and disassembly. We will focus on understanding the chemical design space for the structural behavior of aminoacyl phosphate esters by exploring variations in the amino acid side chains, at the N-terminus of the sequences and in the phosphate esters. Such structural variations can in turn direct different pathways when transferring energy and reactivity for the formation and destruction of assemblies. Incorporating structural elements around non-biological phosphates represents an unexplored opportunity to impact reaction networks, by developing phosphate-driven supramolecular systems chemistry.²

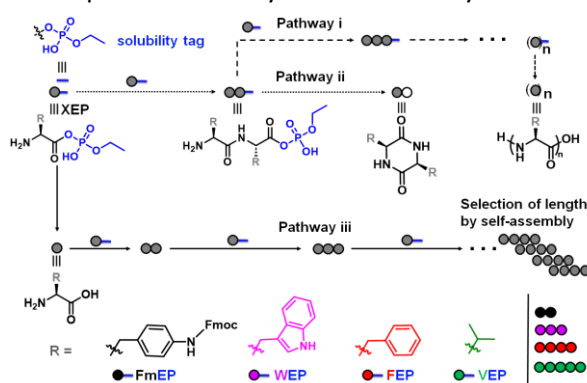


Fig. 1. Spontaneous and selective peptide oligomerization driven by aminoacyl phosphate esters and phase changes.

Relevant publications

1. Dai, K.; Pol, M.; Saile, L.; Sharma, A.; Liu, B.; Thomann, R.; Trefs, J.; Qiu, D.; Moser, S.; Wiesler, S.; Balzer, B.; Hugel, T.; Jessen, H.; Pappas, C. G., Spontaneous and Selective Peptide Elongation in Water Driven by Aminoacyl Phosphate Esters and Phase Changes. *J. Am. Chem. Soc.* doi.org/10.1021/jacs.3c07918, **2023**.
2. Pol, M.; Dai, K.; Thomann, R.; Moser, Pappas, C. G., Guiding Transient Peptide Assemblies with Structural Elements Around Abiotic Phosphate Fuels. *ChemRxiv*, **2023**, DOI: 10.26434/chemrxiv-2023-n24kf

Candidate profile

For this project interdisciplinary competences ranging from organic and analytical chemistry to supramolecular and systems chemistry are desirable. The potential PhD candidates are therefore expected to have a master degree with outstanding grades in one of the following fields (chemistry, polymer science, functional materials) and the strong willingness to work interdisciplinary. Previous experience in one of the following areas (solid and solution phase peptide synthesis, dynamic covalent chemistry, spectroscopic techniques) is appreciated, but it is not a requirement. In addition, strong competences in scientific presentations and writing (in English language) as well as team skills are expected from the successful PhD candidate as he/she will be part of a creative, productive and dynamic research team.

Please hand in:

- **Motivation letter detailing why you are interested in this specific project, what potential ideas you could develop** and how your previous research qualifies you for the project (up to 1,500 words)
- Curriculum Vitae with list of publications (if applicable)
- Certified copies of your university degree(s) with grades (BA and MA certificate / Diploma certificate and transcript)
- Short summary of your master's thesis (up to 1,000 words)
- Two referees with contact details and reference letters

Your documents will not be returned after the application process. For this reason, please submit copies only. This position is for 36 months. The salary will be determined in accordance with TV-L E13.

Please send your application in English including supporting documents mentioned above by 15/01/2024 at the latest. Please send your application to the following address:

Contact person about position:

Charalampos Pappas
charalampos.pappas@livmats.uni-freiburg.de