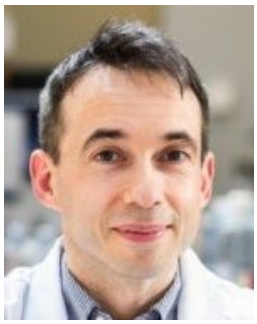
Department Seminar



日時：4 月 24 日（水曜日）、16:00-17:00

場所：工学部 3 号館 8B04 講義室

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(Leverhulme International Professor, Department of Biosciences, Durham University)

Programming Biological Molecules at The Nanoscale

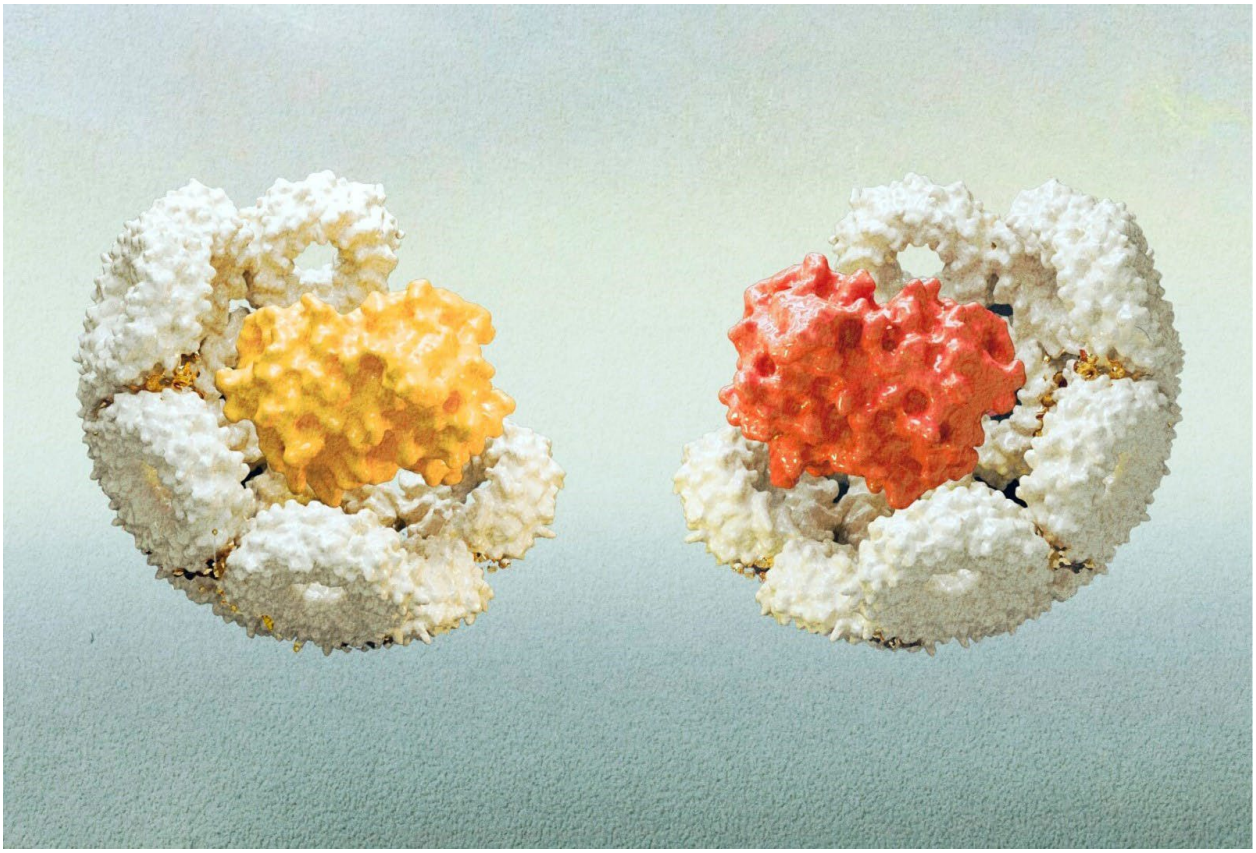
Biological machines in nature provide an inspiration for attempts to design and implement artificial variants with the goal of exceeding nature's capabilities. The newly established Centre for Programmable Biological Matter aims to work towards this goal. Here I will introduce some of our progress in DNA and protein design with an emphasis on our work on protein cages.

Protein cages are useful because they provide an external surface which can be modified, for example with antigens or targeting groups. Their hollow lumen can potentially be filled with useful molecules such as therapeutics. Stable protein cages act as a protective capsule for such agents, shielding them from degradation until they reach their point of action. Recent progress in AI-based protein design has brought new capabilities in designing and making stable, static protein cages. However, it is still difficult to successfully construct protein cages that are stable but also able to disassemble on demand – a necessary capability for targeted release of encapsulated molecules. Here we will describe the development of a protein cage which can be programmed to open in a wide variety of different conditions. Thus, providing the potential for programmable delivery of cargoes.

References

1. Malay, A.D., Miyazaki, N., Biela, A., Chakraborti, S., Majsterkiewicz, K., Stupka, I., Kaplan, C.S., Kowalczyk, A., Piette, B.M., Hochberg, G.K. and Wu, D., 2019. An ultra-stable gold-coordinated protein cage displaying reversible assembly. *Nature*, *569*(7756), pp.438-442.
2. Naskalska, A., Borzęcka-Solarz, K., Rozycki, J., Stupka, I., Bochenek, M., Pyza, E. and Heddle, J.G., 2021. Artificial protein cage delivers active protein cargos to the cell interior. *Biomacromolecules*, *22*(10), pp.4146-4154.
3. Sakai, Y., Wilkens, G.D., Wolski, K., Zapotoczny, S. and Heddle, J.G., 2021. Topogami: Topologically Linked DNA Origami. *ACS Nanoscience Au*, *2*(1), pp.57-63.
4. Piette, B.M., Kowalczyk, A. and Heddle, J.G., 2022. Characterization of near-miss connectivity-invariant homogeneous convex polyhedral cages. *Proceedings of the Royal Society A*, *478*(2260), p.20210679.
5. Majsterkiewicz, K., Biela, A.P., Maity, S., Sharma, M., Piette, B.M., Kowalczyk, A., Gaweł, S., Chakraborti, S., Roos, W.H. and Heddle, J.G., 2022. Artificial protein cage with unusual geometry and regularly embedded gold nanoparticles. *Nano Letters*, *22*(8), pp.3187-3195.
6. Stupka, I., Azuma, Y., Biela, A.P., Imamura, M., Scheuring, S., Pyza, E., Woźnicka, O., Maskell, D.P. and Heddle, J.G., 2022. Chemically induced protein cage assembly with programmable opening and cargo release. *Science Advances*, *8*(1), p.eabj9424.

7. Sharma, M., Biela, A.P., Kowalczyk, A., Borzęcka-Solarz, K., Piette, B.M., Gaweł, S., Bishop, J., Kukura, P., Benesch, J.L., Imamura, M. and Scheuring, S., 2022. Shape-morphing of an artificial protein cage with unusual geometry induced by a single amino acid change. *ACS nanoscience Au*, *2*(5), pp.404-413.
8. Azuma, Y., Gaweł, S., Pasternak, M., Woźnicka, O., Pyza, E. and Heddle, J.G., 2023. Reengineering of an artificial protein cage for efficient packaging of active enzymes. *bioRxiv*, pp.2023-12.



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