

MEDIA RELEASE

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Keeping cells tidy could boost biomanufacturing efficiency

Dr Yu Heng Lau, Centre Member at the ARC Centre of Excellence in Synthetic Biology (CoESB), and his team at the University of Sydney have shed new light on how cells use nano-sized molecular cages to keep their internal contents well-organised. This fundamental discovery could ultimately boost the productivity of biotechnological processes from agriculture to chemical manufacturing.

The nano-sized cages, known as *encapsulins*, act like miniature organs for the cell, housing enzymes that conduct essential functions such as iron storage. Encapsulin cages are made from simple proteins that spontaneously self-assemble into porous icosahedral structures, and work by clustering enzymes together into dedicated confined spaces, thus giving them the right environment to function properly.

A newly published journal article in [Science Advances](#) has revealed how the porosity of encapsulins controls the way in which valuable molecular products can enter and exit these cages. Using cryo-electron microscopy (the technique which was the subject of the 2017 Nobel Prize in Chemistry), the research team designed and solved the structures of synthetic encapsulins with different porosities, providing new insights into why nature uses these molecular protein cages, and how they are able to boost enzyme function.

The team is now taking a synthetic biology approach to re-programming encapsulin cages to boost carbon capture. By using encapsulins to organise the enzymes involved in photosynthesis, they are currently working together with scientists at the Australian National University to create synthetic organelles that can extract CO₂ from the air more efficiently for boosting crop yields in plants.

Dr Lau says 'This work brings us closer to understanding how nature uses protein cages to organise and regulate biocatalysts for optimal productivity. Our next goal is to use these encapsulin protein cages as synthetic organelles for hosting neobiochemistry, two of the main research themes of the CoESB! Planning for a future bio-based economy, this work will be a big step towards reliable re-design of cellular metabolism in engineered organisms to make valuable industrial biochemicals and pharmaceuticals in an efficient and cost-effective manner.'

The ARC Centre of Excellence in Synthetic Biology was established in 2020 with the goal to provide 21st century solutions to global agricultural, food production, manufacturing, healthcare and environmental challenges. The centre brings together 9 Australian universities and a range of partners, such as biotech start-ups, government departments, international university and research facilities, medium to large business and industry bodies. Together they aim to create an environmentally sustainable processing industry, leading to significant rural investment, jobs and new export opportunities.

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