UNIVERSITY OF LIVERPOOL

Postdoctoral Research Associate Position

Engineering functional CO_2-concentrating mechanisms to enhance crop photosynthesis

A postdoctoral position is now open in the lab of Prof. Luning Liu (www.luningliu.org) at the Department of Biochemistry and Systems Biology, University of Liverpool, United Kingdom.

Salary: £36,386 - £42,155 pa

Project Description

With the global demand for food increasing, there is a growing interest in improving photosynthesis to sustainably enhance crop production. We focus on the formation and bioengineering of bacterial CO_2-fixing organelles, the carboxysomes, which are found in cyanobacteria and proteobacteria and make a great contribution to the global carbon cycle (*1-12*). Carboxysomes encapsulate Rubisco and carbonic anhydrase using a polyhedral protein shell, and the natural architectural features of carboxysomes ensure the signification elevation of CO_2 levels around Rubisco to improve photosynthetic carbon fixation. By gaining a system atic understanding of carboxysome assembly and engineering, we have achieved an exciting development of generating transgenic tobacco lines that produce Rubisco with fast carboxylation and functional carboxysomes in chloroplasts (*13, 14*).

Building on these breakthroughs and the collaboration with Prof Peter Nixon (Imperial College London) and Prof Tracy Lawson (University of Essex), the Postdoctoral Research Associate in this project will develop strategies for designing and generating next-generation tobacco lines with improved CO_2 assimilation and plant growth. This project will provide a novel scientific solution for biological engineering of crops and reprogramming chloroplast CO_2-fixing metabolism, with the intent of supercharging crop photosynthesis and sustainable agricultural production to address the challenges facing food and energy security.

Qualifications

Qualified candidate should have a PhD in Plant Sciences/Plant biotechnology or equivalent, and should have strong experience in plant growth, plastid/nuclear transformation, and genotyping/phenotyping. Knowledge in protein biochemistry would be an advantage.

The candidate should have demonstrated:

- excellent scientific productivity, evidenced by high-quality research publications
- enthusiasm, motivation, flexibility and confidence
- to conduct independent and creative research
- to be highly organized and can manage workload to meet deadlines

- an analytical aptitude for devising innovative scientific or technical solutions
- good inter-personal and communication skills, both oral and written

Employment and Personal Development

The position is intended to start as soon as possible (the state date is negotiable) until 30 September 2024 with the possibility of extension. The annual salary is within the range of **£36,386 - £42,155**. The postdoc researcher will work in a multidisciplinary research team across plant engineering, synthetic biology, microbiology and biochemistry, supported by state-of-the-art infrastructure of the University (Plant Sciences, Synthetic Biology, Bio-Imaging, Structural Biology, Protein Production), and will work with collaborators in the UK, Europe, US, and Asia, which is a great opportunity for career development.

Application procedure

Please submit your application or make enquiries to Prof. Luning Liu (Email: luning.liu@liverpool.ac.uk, website: www.luningliu.org).

Your application should include the following documents:

- Curriculum vitae, incl. educational qualifications, experience, skills and a list of publications
- Motivation letter, incl. a brief summary of past and current research accomplishments
- Names and contact details for 2-3 referees

References

1. L. N. Liu, Advances in the bacterial organelles for CO_2 fixation. *Trends in Microbiology* **30**, 567-580 (2022). (Cover article)
2. Y. Sun *et al.*, Decoding the Absolute Stoichiometric Composition and Structural Plasticity of α-Carboxysomes. *mBio* **13**, e0362921 (2022).
3. T. Ni *et al.*, Structure and assembly of cargo Rubisco in two native α-carboxysomes. *Nat Commun* **13**, 4299 (2022).
4. J. Huang *et al.*, Probing the Internal pH and Permeability of a Carboxysome Shell. *Biomacromolecules* **23**, 4339-4348 (2022). (Cover article)
5. T. Chen *et al.*, Incorporation of Functional Rubisco Activases into Engineered Carboxysomes to Enhance Carbon Fixation. *ACS Synth Biol* **11**, 154-161 (2022). (Cover article)
6. T. Li *et al.*, Reprogramming bacterial protein organelles as a nanoreactor for hydrogen production. *Nature Communications* **11**, 5448 (2020).
7. F. Huang *et al.*, Rubisco accumulation factor 1 (Raf1) plays essential roles in mediating Rubisco assembly and carboxysome biogenesis. *Proc Natl Acad Sci USA* **117**, 17418-17428 (2020).
8. M. Faulkner *et al.*, Molecular simulations unravel the molecular principles that mediate selective permeability of carboxysome shell protein. *Scientific Reports* **10**, 17501 (2020).
9. Y. Sun, A. J. M. Wollman, F. Huang, M. C. Leake, L. N. Liu, Single-organelle quantification reveals the stoichiometric and structural variability of carboxysomes dependent on the environment. *Plant Cell* **31**, 1648-1664 (2019).
10. F. Huang *et al.*, Roles of RbcX in carboxysome biosynthesis in the cyanobacterium *Synechococcus elongatus* PCC7942. *Plant Physiol* **179**, 184-194 (2019).
11. M. Faulkner *et al.*, Direct characterization of the native structure and mechanics of cyanobacterial carboxysomes. *Nanoscale* **9**, 10662-10673 (2017).
12. Y. Sun *et al.*, Light modulates the biosynthesis and organization of cyanobacterial carbon fixation machinery through photosynthetic electron flow. *Plant Physiol* **171**, 530-541 (2016).
13. T. Chen *et al.*, Producing fast and active Rubisco in tobacco to enhance photosynthesis. *Plant Cell* **35**, 795-807 (2023). (Cover article)
14. T. Chen *et al.*, Engineering α-carboxysomes into plant chloroplasts to support autotrophic photosynthesis. *Nature Communications* **in press**, (2023).