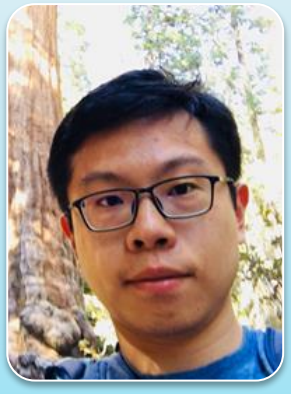
Assistant Prof. Sheng-Sheng Yu

游聲盛 助理教授

Ph.D.： School of Chemical & Biomolecular Engineering,
Georgia Institute of Technology
Email： ssyu@mail.ncku.edu.tw
Phone： 886-6-2757575 ext. 62628
Office： Room No.93B16 (11F)



Research Interests

Our group focuses on developing green and sustainable processes for polymeric materials. More specifically, we combine polymer chemistry, biochemistry, and mathematic modeling to reduce the cost and environmental impacts of producing valuable materials. We are also interested in synthesizing hybrid materials from biopolymers and synthetic polymers for biomedical application.

(1) Development of an environment-friendly peptide synthesis

Peptides are high-value products in various industries, but their production is expensive and toxic. In this project, we will combine a green reaction media and the ester-mediated amide bond synthesis as a new route for the mass production of polypeptides.

(2) Emulsion polymerization of sustainable polymer latexes

Synthesizing polymers from sustainable resources has been an emerging area. We will use miniemulsion polymerization to reduce the environmental impact of producing sustainable polymers and expand their application.

(3) Hybrid materials from sustainable polymers and proteins

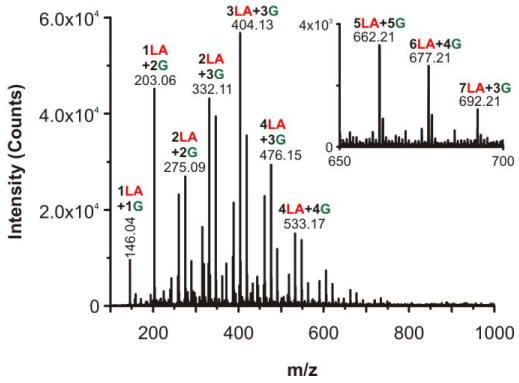
The performance of sustainable polymers is still inferior to polymers from petrochemical feedstocks. Here, we will conjugate biopolymers with sustainable polymers and use this new composite for 3D printing and biomedical application.

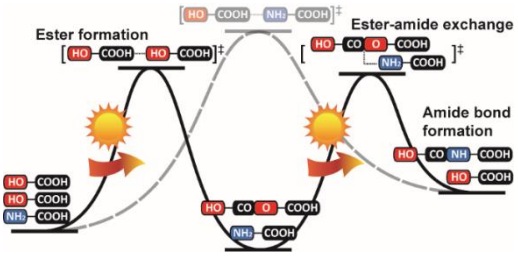
Representative Publications

1. **Yu, S.-S.**; Solano, M. D.; Blanchard M. K.; Soper-Hopper, M. T.; Krishnamurthy, R.; Fernández, F. M.; Hud, N. V.; Schork, F. J.; Grover, M. A., Elongation of model prebiotic proto-peptides by continuous monomer feeding. *Macromolecules* **2017**, 50 (23), 9286-9294.
2. Soper-Hopper, M. T.; Petrov, A. S.; Howard, J. N.; **Yu, S.-S.**; Forsythe, J. G.; Grover, M. A.; Fernández, F. M., Collision cross section predictions using 2-dimensional molecular descriptors. *Chem. Comm.* **2017**, 53 (54), 7624-7627.
3. Forsythe, J. G.; Petrov, A. S.; Millar, W. C.; **Yu, S.-S.**; Krishnamurthy, R.; Grover, M. A.; Hud, N. V.; Fernández, F. M., Surveying the sequence diversity of model prebiotic peptides by mass spectrometry. *Proc. Natl. Acad. Sci. USA.* **2017**, 114 (37), E7656-E7659.
4. **Yu, S.-S.**; Krishnamurthy, R.; Fernández, F. M.; Hud, N. V.; Schork, F. J.; Grover, M. A., Kinetics of prebiotic depsipeptide formation from the ester-amide exchange reaction. *Phys. Chem. Chem. Phys.* **2016**, 18 (41), 28441-28450.

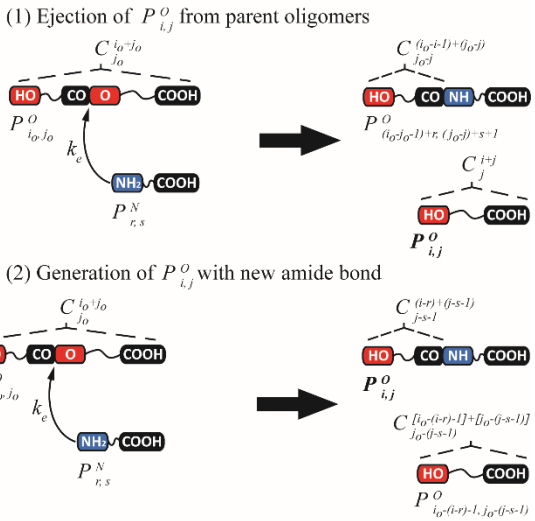
5. Forsythe, J. G.[+]; **Yu, S.-S.**[+]; Mamajanov, I.; Grover, M. A.; Krishnamurthy, R.; Fernández, F. M.; Hud, N. V., Ester-mediated amide bond formation driven by wet–dry cycles: A possible path to polypeptides on the prebiotic earth. *Angew. Chem. Int. Ed.* **2015**, 54 (34), 9871-9875. (co-first authors)
6. Grover, M.; He, C.; Hsieh, M.-C.; **Yu, S.-S.**, A chemical engineering perspective on the origins of life. *Processes* **2015**, 3 (2), 309-338.

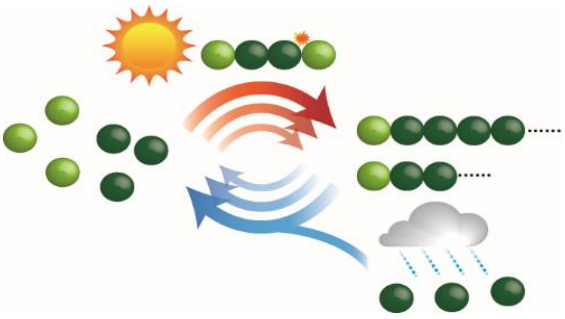
Hydroxy acids such as glycolic acid or lactic acid were used as key compounds to facilitate peptide formation under a mild condition via the ester-amide exchange reaction. Our research received attentions from various news outlets such as *C&E News, Daily Mail UK, and R&D Magazine* for its importance in prebiotic chemistry.

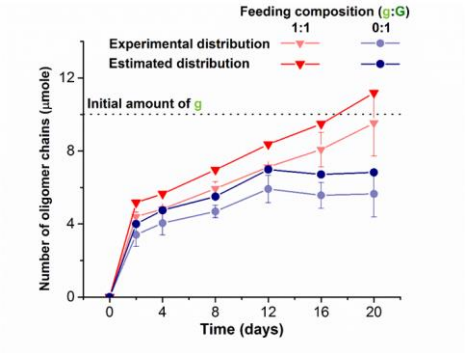




To further understand the kinetic behavior of the ester-mediated copolymerization. A mathematical model was developed to simulate the reactions and evaluate the rate constants for each step. Further calculations showed that the ester-mediated pathway facilitates amide bond formation by lowering activation entropies.







We also built an automated machine to study the ester-mediated copolymerization under various reaction conditions. The combination of the esterification and ester-amide exchange is similar to the behavior of the living polymerization. Adding more hydroxy acids creates more active chains, but does not necessarily elongate the oligomer chains. The average chain length grows more rapidly when the number of active chains is limited.