

## Synthetic cellularity and community in chemical system

### Yan Qiao

Professor

Beijing National Laboratory for Molecular Sciences, State Key Laboratory of Polymer Physics and Chemistry, CAS Research/Education Center for Excellence in Molecular Sciences, Institute of Chemistry, Chinese Academy of Sciences, Beijing 100190, China

University of Chinese Academy of Sciences, Beijing 100190, China

Email: [yanqiao@iccas.ac.cn](mailto:yanqiao@iccas.ac.cn)



### **Abstract**

The chemical construction of rudimentary forms of artificial cell-like entities (protocells) may provide some inspiration for the origin of life. Recently, some progresses arise in the new types of protocells and their biomimetic functions. However, cells do not exist in isolation. Collective behavior of protocell populations, synthetic protocell communities, and the communication with environment are of great significance to the generation and evolution of cells. The investigation of these topic has difficulties with design and construction of protocell communities with life-like communications, and also obstacles with statistic investigation method. Here we demonstrate an artificial form of predatory behaviour in a community of protease-containing coacervate micro-droplets and protein-polymer microcapsules (proteinosomes) that interact via electrostatic binding. Furthermore, a ternary protocell community was designed with multiple enzymatic reactions realized secretory pathways and direct communication, selective communication and controllable recognition, and feedback loop. Our results highlight opportunities for the development of interacting artificial protocell communities and protocell ecosystem, and provide a strategy for inducing collective behaviour in soft matter micro-compartmentalized systems and statistic investigation method.

### **Brief Biography**

Prof. Yan Qiao is working in the intersection of chemistry, biology and material. Her lab, established in 11.2017 mainly focuses on protocell or synthetic cell. The primary goal of her research team is to chemically construct compartmentalized micro-ensembles that collectively exhibit key aspects of protolife biological behavior and interaction of protocell communities; to develop the application of synthetic cells for use in areas such as soft robotics, light harvesting, remote sensing, monitoring and delivery of therapeutic agents et al. Prof. Qiao has authored over 30 peer-reviewed papers, which have received a total citation of more than 1,000 times. She was listed as 14th National Thousand Talents, Hundred Talents of ICCAS, and awarded Eli Lilly Asia Outstanding Graduate Thesis Award (1st level), Outstanding Student on Colloids and Interface Chemistry of China (EDIC Cup, 1st level), Outstanding Doctoral Thesis Award and Outstanding Graduates Award of Peking University.

### **Brief CV**

## **Yan Qiao, Ph.D.**

Beijing National Laboratory for Molecular Sciences, State Key Laboratory of Polymer Physics and Chemistry, Institute of Chemistry, Chinese Academy of Sciences

### **Education:**

B.S School of Chemical Engineering and Technology, Tianjin University, China, 2005

Ph.D College of Chemistry and Molecular Engineering, Peking University, 2011

### **Professional Career:**

2011-2014: Institute of Physics, Humboldt University of Berlin, Germany, Postdoc;

2014-2017: School of Chemistry, University of Bristol, UK, Postdoc;

2017- present: Institute of Chemistry, Chinese Academy of Sciences, Professor,

### **Research Interests:**

1. chemically construct compartmentalized micro-ensembles that collectively exhibit key aspects of protolife biological behavior and interaction of protocell communities;
2. synthetic cells for use in areas such as soft robotics, light harvesting, remote sensing, monitoring and delivery of therapeutic agents et al.

### **Selected publications**

- (1) L. Xu, C. Wang, Y. Cui, A. Li, **Y. Qiao\***, D. Qiu\*, Conjoined-network rendered stiff and tough hydrogels from biogenic molecules, *Sci. Adv.*, 2019, 5, eaau3442.
- (2) C. Wang, L. Xu, **Y. Qiao\***, D. Qiu\*, Adhesives to empower a manipulator inspired by the chameleon tongue, *Chinese Chemical Letters*, 2019, DOI: 10.1016/j.ccllet.2019.05.018.
- (3) R. Booth, **Y. Qiao**, M. Li\*, S. Mann\*, Spatial positioning and chemical coupling in coacervate-in-proteinosome protocells, *Angew. Chem. Int. Ed.*, 2019, 58, 9120–9124.
- (4) N. Martin, J. P. Douliez, **Y. Qiao**, R. Booth, M. Li, S. Mann\*, Antagonistic Chemical Coupling in Self-Reconfigurable Host-Guest Protocells, *Nat. Commun.*, 2018, 9, 3652.
- (5) **Y. Qiao**, M. Li, R. Booth, S. Mann\*, Predatory Behaviour in Synthetic Protocell Communities, *Nat. Chem.*, 2017, 9, 110. (cover paper)
- (6) H. Dou, M. Li, **Y. Qiao**, R. Harniman, X. Li, C. E. Boott, S. Mann\*, I. Manners\*, Higher-Order Assembly of Crystalline Cylindrical Micelles into Membrane-Extendable Colloidosomes, *Nat. Commun.*, 2017, 8, 426.
- (7) **Y. Qiao\***, F. Polzer, H. Kirmse, E. Steeg, S. Kühn, S. Friede, S. Kirstein\*, J. P. Rabe, “Nanotubular J-Aggregates and Quantum Dots Coupled for Efficient Resonance Excitation Energy Transfer” *ACS Nano*, 2015, 9, 1552.