Nanocoated bacterial therapeutics

*Jinyao Liu**

1630 Dongfang Road
Shanghai Jiao Tong University
Shanghai, China
jyliu@sjtu.edu.cn

As appealing living agents, bacteria not only play beneficial effects in immune modulation and homeostasis maintenance, but also are able to target and colonize specific bio-interfaces. As such, bacteria have been widely applied as either therapeutic agents or drug delivery vehicles for treating different diseases. However, the use of bacteria in vivo inevitably suffers from significant challenges, including rapid immune clearance, insufficient bioavailability, dose-dependent side effect, and uncontrolled colonization.

Surface nanocoating of living bacteria can introduce different functional motifs on the surface and endow coated bacteria with various unique characteristics for application in disease treatment. Herein, strategies that are able to form an entire coating on bacterial surface are first introduced:[1-4] 1) a chemical strategy of forming coated living bacteria by interfacial self-assembly, which enable functional compositions to assemble on bacterial surface; 2) a convenient physical strategy of coating bacteria with eukaryotic cell membranes from red cells and yeast cells by mechanical extrusion; and 3) a biological strategy of encapsulating bacteria through either using a specific culture medium to induce the production of biofilm-self-coated bacteria or employing irradiation to trigger the formation of apoptotic body-coated bacteria. Then, coated bacteria that can be endowed with a wide range of coating-derived exogenous functions are highlighted and their appealing characteristics of reduced immune clearance, increased bioavailability, improved safety, and preferential colonization for treating diseases, particularly inflammatory bowel diseases and different types of cancer, are also enumerated. It is anticipated that the introduction of the progresses and perspectives of bacterial surface engineering can provide insights to guide further research to explore innovative living bacterial agents for various biomedical applications.

References:

[1] L Wang, J Liu*, *Nature Biomedical Engineering* **2023**, *7*, 3.
[2] Y Chen, S Lin, L Wang, Y Zhang, H Chen, Z Fu, M Zhang, H Luo, J Liu*, *Nature Biomedical Engineering* **2024**, *8*, 823.
[3] S Lin, G Xie, J He, L Meng, Y Pang, J Liu*, *Nature Biomedical Engineering* **2025**, doi.org/10.1038/s41551-025-01354-3
[4] Z Cao, J Liu*, *Nature Protocols* **2024**, *19*, 3162.