Droplet-Engineered Organoid Models for Precision Drug Screening: A Surfactant-Enabled Microfluidic Approach

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The U.S. FDA has recently endorsed the use of organoid models as viable alternatives to animal testing in drug development,[1] spotlighting their potential to transform precision medicine. Organoids have emerged as powerful in vitro models for capturing the cellular and molecular complexity of human diseases, yet their scalability, reproducibility, and physiological fidelity remain key challenges—especially for high-throughput drug screening. In this talk, I will present a novel droplet-engineered organoid platform enabled by a patented thermo-responsive polymer surfactant (PCT/AU2024/050169),[2,3] developed by our team to overcome many of the limitations associated with conventional organoid culture. This biocompatible surfactant allows the generation and recovery of uniform microdroplets through simple temperature modulation, without toxic chemicals or harsh wash steps, thereby preserving cell viability and native phenotypes.

Using this platform, we create reproducible, cell-laden microdroplets that mimic the cell niche by supporting cellular self-organisation both within and around the droplet perimeter. These miniature "ecosystems" can be readily engineered with specific biochemical and biomechanical cues to model tumour heterogeneity and microenvironmental interactions.

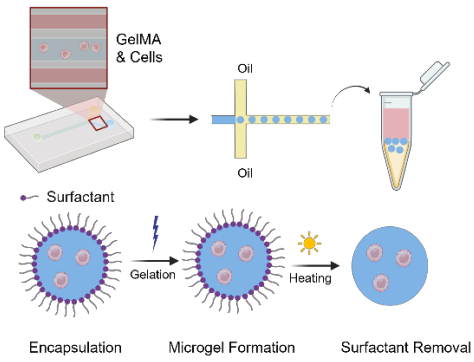

Figure 1: Cell-laden microgel

References:

1 (U.S. Food&Drug Administration, 2025).
2 Li, X. K. *et al.* Qiao, R.*, Tailored Fluorosurfactants through Controlled/Living Radical Polymerization for Highly Stable Microfluidic Droplet Generation. *Angew Chem Int Edit* **63** (2024).
3 Cheng, X. R. *et al.* Qiao, R.*, Zhang, C*, Functional Fluoropolymer Surfactants for Droplet Generation in Microfluidics. *ACS Applied Polymer Materials* **6**, 14401-14409 (2024).