

Automated Panel Mixing for Spatial Biology and Flow Cytometry with the Parhelia Spatial Station™

Introduction

Spatial biology and flow cytometry are time-tested hallmarks of cellular biomarker discovery and clinical practice. Advances in fluorescent probe chemistry, laser optics, detection methods, and bioinformatics are enabling a renaissance in both techniques, paving the way for comprehensive monitoring of the biochemical central dogma through complex multiomics analysis.

As studies include a growing number of antibody and oligonucleotide-based markers, designing and producing appropriate panels (or cocktails) becomes more complex and daunting to researchers. While

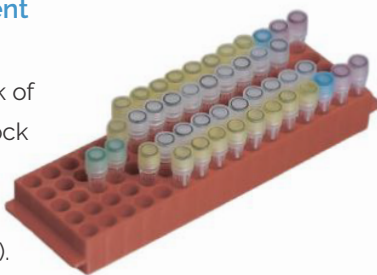
precise panel design is essential for successful spatial biology (1) and flow cytometry (2) experiments, manual preparation necessarily involves increased systematic errors, inter-operator variability, and researcher hands-on time. Such drawbacks risk repeating experiments or overlooking significant biomarker differences between study groups, costing significant time and wasting expensive reagents.

Advances in high-content analysis demand purpose-built, automated sample preparation workflows that seamlessly integrate with the specimen-to-data pipeline (2).

Challenges of Manual Panel Mixing

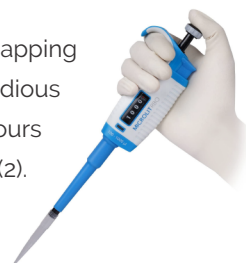
Inventory Management

Handling multiple antibodies raises the risk of cross-contaminating stock vials, using the wrong antibody, or excessive temperature variation (2).



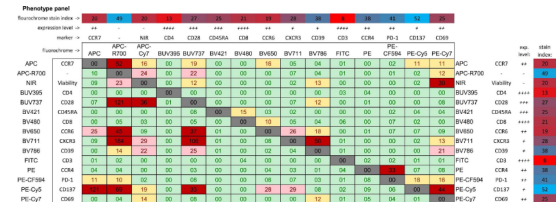
Labor-Intensive

Manual pipetting, capping & de-capping tubes, and mixing antibodies is tedious and time-consuming, taking ~3 hours of attention for a 25-probe panel (2).



Optimization

Larger panels demand additional FMO controls and optimization (e.g., to address spectral overlap and compensation) requiring further manual processing (3).



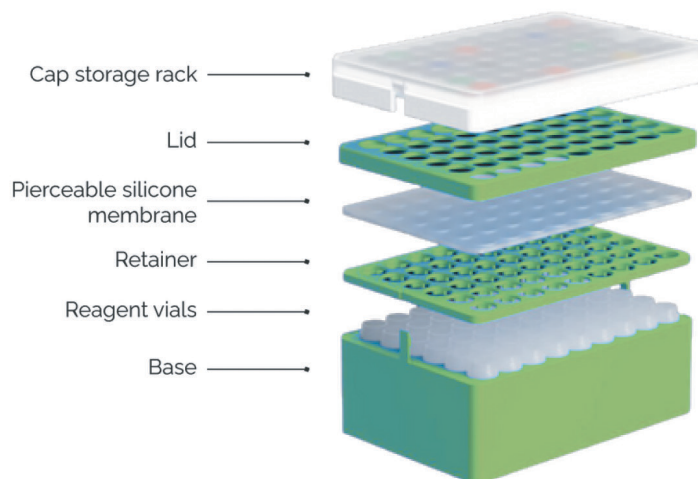
Consistency

Generating the correct antibody concentrations in larger panels or using oligo-tagged antibodies (e.g., CITE-Seq) is error-prone, typically requiring a ~25% volume coverage in the cocktail (4).



Solution: Automated Panel Mixing

Generate fully automated custom panels with the Parhelia Spatial Station™. The P54 module securely holds up to 54 uncapped antibody vials with a silicone membrane. For each antibody, a fresh pipette tip pierces the silicone membrane prior to aspiration, avoiding cross-contamination. The entire P54 module can be further sealed with a lid and stored according to the antibody manufacturer's specifications. Furthermore, the system accommodates large plex panels by deploying multiple P54 modules.



The P54 module enables the pipetting and storage of up to 54 antibody vials.

Welcome Aboard the Spatial Station

Like astronauts performing experiments in space, researchers utilizing spatial biology techniques need a multifunctional habitat to execute protocols and safeguard their specimens. With the Parhelia Biosciences Spatial Station, you can customize panel mixing, eliminate manual tube handling, and manage your antibody inventory with precise volume tracking and secure, uncapped storage, all in a matter of minutes. Designed to automate complicated sample preparation protocols, the Spatial Station seamlessly integrates your multiomics workflows into one turnkey benchtop workstation.



Edit protocols easily with an intuitive **touchscreen**

Track remaining reagent levels with **precision liquid sensing**

Integrate multiple assays with **automated staining** and a **heating + cooling module**

Run protocols unconstrained by waste capacity with **waste management**

Ensure compliance with safeguards like **labware autodetection** and a **step-by-step Run Report**

References

- (1) Kuswanto W, Nolan G, and Lu G. (2023) Semin Immunopathol. 45(1): 145–157.
- (2) Bosteels V et al. (2024) Cytometry. 105(6): 464–473.
- (3) Holmberg-Thyden S et al. (2021) Anal Biochem. 627: 114210.
- (4) Nettersheim F et al. (2022) Sci Rep. 12: 20817.