Comparison of 10x Genomics Xenium and Vizgen's MERSCOPE Ultra
for high-throughput *in situ* hybridization (ISH) analyses

High Throughput Genomics Core, Academia Sinica, Taiwan
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Summary
10x Xenium Analyzer: Currently focuses on RNA analysis, with plans to incorporate simultaneous protein detection in future updates.
MERSCOPE Ultra: Provides capabilities for co-detection of proteins and transcripts, offering protein staining and a user-friendly workflow.
* For targeted gene studies (100s–5,000 genes) with automation and clinical sample compatibility (FFPE), 10x Xenium is the better choice.
* For non-clinical samples, Merscope has more publications for reference.
* Both systems are equipped with imaging and computation; Xenium computation workflow is more streamlined.

Factors to consider when choosing between the platforms

Decision Factor	Best Choice
Clinical Applications (FFPE & Targeted Panels)	10x Xenium
Automated Workflow & Ease of Use	10x Xenium
Single-Molecule Resolution & High Sensitivity	MERSCOPE Ultra
Lower Computational Complexity	10x Xenium
Neuroscience, Brain Atlas, & Developmental Biology	MERSCOPE Ultra

1. Core Technology & Approach

Feature	10x Genomics Xenium	Vizgen MERSCOPE Ultra
Detection Strategy	Padlock probes + Rolling Circle Amplification (RCA)	MERFISH (Multiplexed Error-Robust Fluorescence *In Situ* Hybridization)
Readout Method	Fluorescence-based signal amplification & high-resolution imaging	Sequential fluorescence imaging with barcoded probes
Multiplexing Strategy	100s–5,000+ genes (targeted panels)	Has validated 1,000 genes custom panel. (10,000+ genes is possible using homebrew MERFISH, not available for MERSCOPE)

2. Gene Detection & Sensitivity

Gene Panel Size	100s–5,000 genes	up to1,000 genes panel
Sensitivity	High, strong amplification via RCA	Higher sensitivity, enables more transcript detection
False Discovery Rate (Specificity)	Lower FDR, higher specificity	May detect more transcripts, but with potential for background noise. can do tissue clearing and photoquench to improve signal
Throughput	High, optimized for targeted panels	Very high, optimized for large-scale transcriptome-wide studies

3. Spatial Resolution & Tissue Compatibility

Resolution	Subcellular (~100 nm-200 nm precision per transcript)	≤100 nm resolution
Cell Segmentation	Uses Multimodel staining & automated segmentation	Uses DAPI/nuclear stains & high-resolution imaging. Vizgen also has cell boundary staining option to assist with cell segmentation
Tissue Compatibility	Fresh frozen & FFPE	Fresh frozen, FFPE compatibility improving

4. Imaging & Computational Workflow

Instrument	Fully automated Xenium Analyzer	Equipped with high-end fluorescence microscope
Imaging Mode	Automated high-throughput multiplexed imaging	Super-resolution sequential imaging
Data Processing	Onboard analysis	Equipped with high performance analysis PC, automated image processing
Analysis Pipeline	10x Genomics pipeline with segmentation & mapping	compatible with common used 3rd party tool such as Seurat, Scanpy

5. Protein Co-Detection Capabilities

Feature	10x Genomics Xenium	Vizgen MERSCOPE Ultra
Current Status	As of now, Xenium primarily focuses on high-throughput RNA mapping. However, the platform is designed with flexibility in mind, and there are plans to incorporate simultaneous protein detection in future updates.	MERSCOPE Ultra currently offers the capability to co-detect proteins and transcripts within the same tissue sample. Using Vizgen's MERSCOPE Protein Stain Kits, researchers can detect up to six proteins simultaneously alongside hundreds to thousands of RNA species.
Protein Staining Quality	Not applicable currently, as protein detection is not yet implemented.	The MERSCOPE Protein Stain Reagent Kit provides high-quality protein staining, equivalent to traditional immunofluorescence staining, ensuring reliable protein detection.
Workflow Integration	Future developments aim to integrate simultaneous RNA and protein detection, enhancing the platform's capabilities.	The platform supports a user-friendly workflow for protein co-detection, allowing researchers to perform multiplexed protein and RNA imaging efficiently.
Data Analysis	With future updates, the platform plans to offer integrated analysis for both RNA and protein data, providing a comprehensive view of gene and protein expression *in situ* .	MERSCOPE Ultra's Visualizer software enables interactive visualization of MERFISH spatial genomics data, allowing researchers to explore detected transcripts, imaged proteins, and segmented cell boundaries seamlessly.

6. Application Suitability

Feature	10x Genomics Xenium	Vizgen MERSCOPE Ultra
Single-Cell Spatial Profiling	✓ Yes, optimized for targeted panels	✓ Yes, single-molecule resolution
Whole-Transcriptome Analysis (~10,000 genes)	✗ not supported (**Option: CyAssit Visium HD**)	✗ not supported with whole transcriptome yet
Clinical & FFPE Applications	✓ Supported	✓ FFPE compatible
High-Throughput Single-Cell Resolution	✓ Yes	✓ Yes
Neuroscience / Brain Atlas Studies	✓ Good for targeted studies	✓ Best for high-gene-count mapping
Cancer Research	✓ High-quality data in FFPE	✓ Strong for fresh-frozen
Developmental Biology & Spatial Gene Expression Mapping	✓ Well-suited	✓ Ideal for broad transcriptomic analysis

7. Strengths & Limitations

Feature	10x Xenium Strengths	MERSCOPE Ultra Strengths
Key Strengths	- Fully automated workflow - **High specificity** (low false positives) - Suitable for **clinical FFPE samples** - Lower computational burden	up to 1000 genes; Lower optical crowding due to barcoding
Limitations	- Limited gene panel size (100s–5,000s) - Expensive new panels	Merscope Ultra include high resolution microscope and high performance analysis PC. Longer imaging time