SmartBioSurface® Slides

Single-Cell Laser Microdissection (LCM)

Instructions for Use

Doc. No.: LCM-IFU-001 Revision: 1.0 Date: 2026-06-03

⚠ FOR RESEARCH USE ONLY — NOT FOR DIAGNOSTIC USE ⚠

1. Intended Use

SmartBioSurface® slides are intended for Research Use Only (RUO) and are used for laser microdissection of single cells for downstream analysis.

SmartBioSurface® slides are coated with a thin nanostructured titanium dioxide (TiO_2) coating [1] that is compatible with UV laser cutting and provides efficient release of single cells after laser microdissection. The coating does not interfere with optical imaging, laser focusing, cutting, or cell recovery.

SmartBioSurface® slides provide a versatile platform for single-cell laser microdissection workflows, supporting fixation, staining, and efficient cell isolation. They are compatible with both catapulting- and gravity-based systems and suitable for downstream DNA-, RNA-, and protein-based molecular analyses, depending on the experimental design.

The device does not provide specific results as it is involved in the treatment process aimed at preparing the sample for the next step; therefore, the device does not provide any interpretable analytical results.

2. Laser Microdissection Overview

Laser microdissection of single cells on SmartBioSurface® slides can be performed using either laser pressure catapulting (LPC) [2] or laser cutting with gravity-assisted collection [3], depending on the laser microdissection platform and collection modality employed.

Parameter settings may vary according to the laser microdissection instrument, software configuration, collection modality, cell type, fixation method, and staining conditions.

In general, PFA-fixed samples, bright-field or combined immunofluorescence/bright-field-stained preparations may require higher laser energy settings compared to unfixed or fluorescence-stained-only samples.

Published studies have demonstrated that SmartBioSurface® slides are compatible with Laser Capture Microdissection after optimization of instrument-specific laser parameters, enabling efficient recovery of intact single cells for downstream molecular applications [3].

3. Instruction for Use

3.1 Slide Preparation

Ensure that the SmartBioSurface® slide is completely dry before laser microdissection:

a) If slides have been stored frozen at -80°c upon cell adhesion, allow them to dry at room temperature under a chemical hood to remove residual humidity before use.
b) Slides that have undergone recent cell adhesion, staining, washing, or fixation procedures must also be completely dry before laser microdissection.
c) For stained slides mounted with coverslips, remove the coverslip before laser microdissection by overnight incubation in Ottix for Bright-field (BF) stained samples mounted using permanent mounting medium or in 1X DPBS for Immunofluorescence (IF) stained samples mounted using a glycerol-based fluorescence mounting medium, and allow the slide to air-dry completely before laser capture microdissection.

3.2 Instrument Setup

1. Place the SmartBioSurface® slide on the laser microdissection microscope stage.
2. Position the collection cap or collection tube according to the instrument collection modality.
3. Identify the target cell under bright-field and/or fluorescence illumination.
4. Adjust the focal plane and laser power according to the laser microdissection system and application requirements.
5. Acquire an image of the target cell before laser microdissection, according to the instrument's imaging capabilities.
6. Define the cutting area, contour, or marker surrounding the target cell according to the microdissection system used.
7. Perform UV laser microdissection of the target cell.
8. According to the instrument collection modality:
    a) Catapult the isolated cell into the collection cap using LPC.
    b) Allow the cell to fall by gravity into the collection tube or cap.
9. Verify:
    a) Complete removal of the target cell from the slide.
    b) Successful recovery of the cell into the collection cap or tube.
10. Acquire an image of the slide after microdissection, showing the absence of the target cell and
11. Acquire, when applicable, an image of the collection cap or collection tube confirming successful cell recovery.
12. Proceed immediately with downstream molecular or cellular analyses or store the collection device at 4°C until further processing.

4. Tested Cell Types and Samples

4.1 Cell Lines Tested

Laser microdissection on SmartBioSurface® slides has been tested on both adherent and non-adherent cell models, including:

- **Adherent cell lines:** SKBR3, 22RV1, A431, BT-474, MCF7.
- **Suspension cell lines/blood-derived samples:** HeLa S3, white blood cells (WBCs) from healthy donors.
- **Mixed spike-in models:** WBCs from healthy donors spiked with BT-474 cells.

4.2 Verified Experimental Conditions

Laser microdissection on SmartBioSurface® slides has been tested and verified under the following experimental conditions:

Cell suspension and seeding conditions

- Cells suspended in PBS
- Cells suspended in serum-free culture medium

Sample fixation conditions

- Unfixed cells
- Paraformaldehyde (PFA)-fixed cells (2–4% PFA)
- Alcohol-fixed samples

Staining conditions

- Unstained samples
- BF-stained samples
- IF-stained samples
- Combined IF + BF-stained samples

5. Troubleshooting

Issue	Possible cause	Corrective action
Incomplete cutting	Fixed or BF-stained sample	Increase laser energy/power
Cell not released	Residual liquid on slide	Ensure the slide is completely dry
Target displacement during cutting	Residual buffer on the slide	Remove all liquids before LCM
Cells barely visible	Low fluorescence signal	Increase exposure or use a brightfield imaging

6. Appendix A – Sample Preparation Before LCM

SmartBioSurface® slides are handled immediately before sample deposition, and the active area is identified by the Teflon-printed boundary. Cell suspensions in isotonic low-protein buffer are seeded as living cells directly onto the coating area using an appropriate volume. Cells are allowed to adhere spontaneously at room temperature for 20–30 minutes, and adhesion efficiency and cell density are verified by light microscopy. After adhesion, the supernatant is removed and cells are fixed with 2–4% paraformaldehyde (when applicable), followed by DPBS 1X washes to remove residual fixative. Slides are either processed immediately for BF or IF staining [4].

References

[1] Zanardi A, Bandiera D, Bertolini F, et al. Miniaturized FISH for screening of onco-hematological malignancies. Biotechniques. 2010; 49(1):497-504. doi:10.2144/000113445

[2] Mastromarino MG, Parini S, Azzolina D, et al. Liquid Biopsy Detecting Circulating Tumor Cells in Patients with Non-Small Cell Lung Cancer: Preliminary Results of a Pilot Study. Biomedicines; 2023 11(1):153. Published 2023 January 7. doi: 10.3390/biomedicines11010153.

[3] Visci G, Tolomeo D, Lonoce A, et al. A novel method for the isolation of single cells mimicking circulating tumour cells adhered on Smart Bio Surface slides by Laser Capture Microdissection. PLoS One. 2024;19(3): e0297739. Published 2024 Mar 8. doi: 10.1371/journal.pone.0297739

[4] Krol I, Schwab FD, Carbone R, et al. Detection of clustered circulating tumour cells in early breast cancer. Br J Cancer. 2021; 125(1):23-27. Published 2021 July. doi: 10.1038/s41416-021-01327-8.