OLYMPUS

Your Vision, Our Future

Laser Microdissection Systems

SmartCut

System Solution

The kindest cut of all: Olympus SmartCut microdissection system

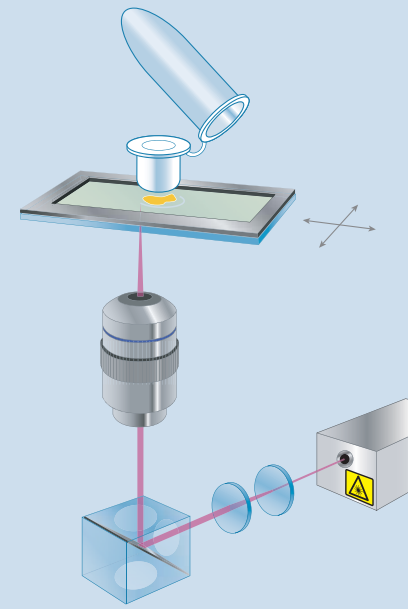
TURN ON: CUT OUT

Microdissection with excellent price-performance ratio

Isolating cells and cell components uncontaminated by neighbouring material is a key task for many processes. For example, extracting diseased cells from their surroundings for analysis or forensic material as part of a criminal case. Traditional protocols can be frustrating, but the new Olympus SmartCut laser microdissection system can be switched on and used instantly. The high-precision, solid-state UVa laser technology provides extremely controllable, contamination-free isolation.

A Principle of microdissection

Fast, precise and contamination-free



Computer-controlled movement

CellTools software-controlled laser focus and energy

AT THE CUTTING EDGE

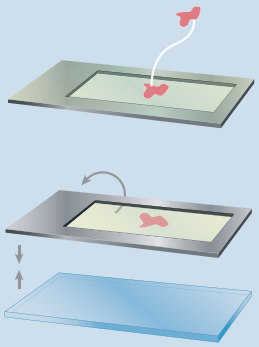
SmartCut is a ready-to-use stand-alone system based on the proven technology of the highly successful CellCut system. It is designed specifically for easy use in daily micromanipulation routines for both fixed and living cells. It is therefore an ideal tool for the isolation of groups of cells, single cells and cell components. As a result, cell biology, molecular pathology, forensic medicine and prenatal diagnostics procedures, as well as teaching and demonstration, all benefit greatly from the rapid and instinctive operation of the SmartCut system.

A With full control provided by the intuitive CellTools software, the microscope sample is shown in 'live view' on the monitor, allowing the user to identify, mark and isolate the target cells. For isolation, the maintenance-free, solid-state UVa laser is focussed via the UIS2 objective onto a microscopical sample, producing a cutting spot of less than 1 µm. This, combined with a picosecond pulse duration and high repetition rate, provides ultra precise and very quick target excision. The CellTools software automatically controls the focus and energy of the laser. To cut out a target, the laser remains aligned to the centre of the optical axis whilst the high-precision motorised stage is used to move the sample. The ultra-low pulse energy of the laser leaves the target unaffected with no impact on downstream processes.

SmartCut's operation is intuitive, so no sophisticated technical know-how or training is required. This means that cells and components can be identified down the microscope, marked using the software and extracted without any vigorous physical or chemical disruption, minimising any sample damage. Moreover, by eliminating contamination as well, cells extracted using SmartCut are more likely to yield high levels of intact proteins, DNA and RNA.

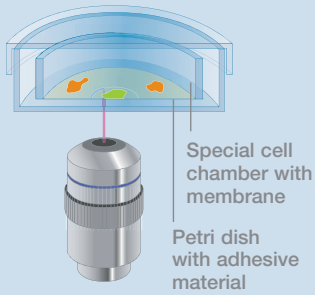
B Sample preparation

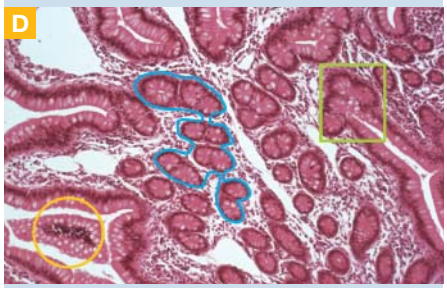
On frame slide with PET membrane



C Excision of live cells

On a microscope





The CellTools software provides different cutting methods (freehand, forms).

Manual CapLift

SAMPLE PREPARATION

To isolate targets from any source, including cryo or paraffin-preserved tissues, smears and cytospins, the Olympus SmartCut uses a metal frame slide with a 1.4 µm PET-membrane. The different types of sample are placed directly on the membrane, which is then inverted and a standard glass slide placed below.

Unique sandwich system

B This unique sandwich effectively protects the sample by forming a complete barrier to contaminants, such as environmental impurities, which is essential for laser microdissection steps. Thus, the sample is ready for the subsequent, highly pure isolation via the adhesive cap of the CapLift microtube. In order to optimise the preparation of delicate samples, standard protocols – such as the use of poly-L-lysine coating or UV exposure to increase cell adhesion – can still be used.

Live culture microdissection

C Using a specialised cell chamber, SmartCut can be used to dissect living cells under sterile conditions. The cells grow in the chamber on a membrane coated with poly-L-lysine and, prior to microdissection, are placed in a Petri dish with an adhesive base. Both parts can be sterilised and are not toxic to the cells.

Easy selection

Selection

D Areas of interest to be extracted are selected on-screen either freehand or using predefined geometric shapes, such as circles, squares and ellipses. Any number of areas across the entire section can be identified and the sizes of the geometric shapes can be changed as well as copied and pasted for consistency.

Automated, quick cutting

With such fine control over cutting, SmartCut can be used on a wide range of sources, making it a highly flexible tool for most laboratories. Target cells are extracted without any damage to their proteins, DNA or- RNA, and as a result, downstream analyses can be carried out with total confidence. In live cell excision the viability of cells is not affected meaning that they can be re-cultured once extracted.

Target recovery

Manual CapLift for fixed cells

E The unique CapLift technology has been developed to maintain the ease of use and contamination-free nature of the SmartCut system. The adhesive cap of a specially adapted microcentrifuge tube is centred to the optical axis of the system to enable user-friendly collection of the selected targets. With the cap kept centred in the optical axis, the motorised stage is moved to enable collection of target cells from across the entire slide.

Isolated targets, stuck to the cap of the microtube, are ready for subsequent downstream processes such as DNA and RNA extraction, as well as protein analysis. Isolation buffer is added and the tube closed for centrifugation to keep the recovery process as short and delicate as possible.

For live cell cultures, a different recovery method is used. Here the culture chamber is removed from the Petri dish under aseptic conditions, leaving the isolated cells behind.

Toolbar and navigation overview

INTUITIVE CONTROL

The CellTools software is used to control the SmartCut system. Its graphical user interface, which also works via an optional unique PenScreen option, allows precise and intuitive identification of the target areas to be excised for the subsequent isolation processes. It also provides full control over the laser cutting parameters, the objective used and specific camera settings in respect of different application-specific requirements. Moreover, all system functions are structured in a way to make them self-explanatory, providing easy operation without any sophisticated technical knowledge or training. Some examples are given below.

Overview and easy navigation

F Using the 4x objective, an overview scan of the entire microscope slide can be made, allowing the user to operate and navigate the system more easily by finding the areas of interest very quickly.

Draw it right

G The PenScreen option enables the selection of target cells and components directly on a touch-sensitive screen using a special pen. This allows the user much greater accuracy in selection, especially for free-form shapes.

Cutting laser control

H To maximise the laser microdissection process, all laser parameters, such as speed, focus and energy, can be changed to match the individual needs of the application, sample and objective. Once set, the parameters are stored for each process and can be easily recalled for use or editing.

Autodocumentation

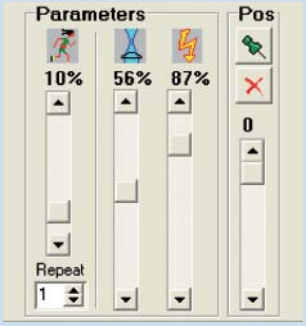
All the data relevant to a session are stored via the autodocumentation mode. This includes the number and size of the cut-out areas, as well as instrument settings and parameters. The isolated targets are documented by the SmartCut system during the cutting and isolation process, and pictures of the remaining sample are automatically acquired and saved – all with multi-user access. This enhances traceability and is proof of a clear, clean and quick isolation process.

G PenScreen

For on-screen target identification

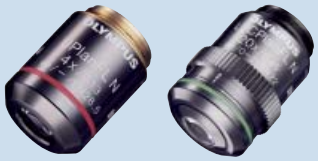
H Laser parameter control

Clear and intuitive setting



I Standard objectives

UPLFLN4x and LUCPlanFLN20x



Peerless image quality

I The SmartCut system is fitted with the advanced Olympus UIS2 objectives. These are produced from a new type of glass that improves laser transmission as well as image contrast and clarity. The UIS2 objectives also have outstanding numerical apertures (NA) and working distances (WD), making them the most essential prerequisite for laser microdissection of small organisms, tissues, single cells or even subcellular structures.

The SmartCut basic system offers a UPLFLN4x – and a long working distance LUCPLFLN20x objective as standard. The SmartCut system can be expanded and optimised in line with the specific needs of the application. A full range of UIS2 objectives is available – 10x, 20x, 40x, 60x and 100x.

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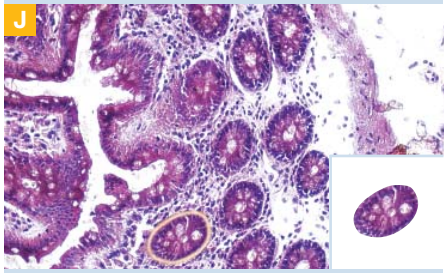
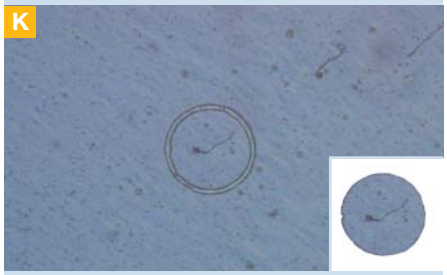


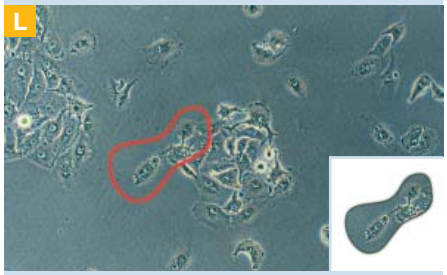
Intestinal gland isolated from transverse tissue sections of colon*

K



Single sperm isolated from a gynaecological smear

L



Cell culture in phase contrast observation

ONE TOOL: MANY APPLICATIONS

SmartCut is an extremely versatile instrument, with applications across many key industries. So whether you are isolating specific cells from an entire tissue, maintaining a pluripotent stem cell line, or extracting a telling foreign cell for forensic investigation, SmartCut performs perfectly time after time after time.

Pathological, haematological and cytological samples

J For example, intestinal glands from colon tissue can be quickly isolated to study specific genes, corresponding hormone response or proteins in locally distinct areas and in comparison with virulent, malignant or benign tissues. Also, any single cell such as an atypical plasmoblast from a blood smear or other relevant cytological cells can be easily identified, cut and isolated for subsequent downstream analysis.

Forensic investigations

K The SmartCut system is an extremely useful tool in forensic medicine, since it can be used, for example, to isolate a single sperm from a vaginal smear for genetic analysis, possibly leading to conviction.

Live cells

L Most stem cell lines are presently grown at high densities on mouse fibroblast “feeder layers”. Therefore, isolating specific pluripotent cells from the surrounding fibroblasts and differentiating cells needs to be rapid, exact and easy. SmartCut offers you the perfect balance between speed, precision and ease of use.

Versatile laser micromanipulation

The SmartCut system can also be used as a laser micromanipulation system. Single, short laser shots produce small self-sealing holes in the plasma membrane of a living sample, which improves protoplast fusion or increases the transfection rates of exogenous substances.

SmartCut specifications

Item	Specification
Technology	
Samples	For all application-relevant samples (cryo or paraffin-preserved tissues, single cells, cytospins,
	cell compartiments, chromosomes, etc.)
“Live cell” handling	Positive and negative cell selection/isolation possible
Picosecond UVa, solid-state laser	Computer-controlled; wavelength: 355 nm; pulse duration: < 600 psec
	Pulse energy/average energy: >0.4 µjoule/approx. 4 mW; repetition rate: > 5 kHz
CapLift technology	Covering full slides; unique and contamination-free sandwich technology
System components	
Microscope	System integrated CKX41 with UIS2 optics, coarse/fine focussing with tension adjustment,
	illumination pillar with 30 W halogen lamphouse,
	long working distance condenser NA 0.3, WD = 72 mm, aperture stop
Tube for observation and documentation	U-CTR30-2-2 trinocular tube with lead-free optics and two WHB10x-2(H), FN20,
	adjustable dioptre range (± 5 dioptre) on left sleeve
	30° inclination and pupillary distance adjustment from 48–75 mm,
	fixed 50/50 light distribution and U-TV0.35xC camera adapter w. c-mount and 0.35x magnification
Nosepiece, UIS2 objective	Quadruple revolving nosepiece with two UIS2 objectives providing excellent UV/IR transmission,
	a) UPLFLN4x/0.13 objective with 4x magnification, NA 0.13 and WD of 17 mm,
	b) LUCPLFLN20x/0.45 objective with 20x magnification, NA 0.45, WD from 6.6 to 7.8 mm
	and variable cover correction from 0 to 2 mm via correction collar
	Other UIS2 objectives for microdissection with NA and WD specified to application on request
Digital camera with high sensitivity	Digital colour: 1,032 x 776 pixels with integrated 1/3” interline progressive CCD
	Compact housing and FireWire connection
CellTools software basic functions	Laser energy and focus control
	Full slide and Petri dish control
	Saving multi-user profiles
	MultiGroup function across entire sample/slides
	Autodocumentation for sample, images and parameters
PC and monitor	Windows XP, 19” LCD monitor
	Specifications will be continuously updated according to market development
Motorised stage	Computer-controlled for high-precision movement/cutting
	Travelling range: 120 x 100 mm; step width: 0.025 µm; repositioning accuracy: 2 µm
Options	
PenScreen system operation	Sensitive 20” touch screen monitor for user-friendly system operation
	and to allow direct target identification with a special pen
Consumables	
Membrane slides	MMI-SLIDE-50SEO RNase free, box of 50
IsolationCaps	MMI-CAP XXX caps, special microtube with adhesive lid, with or without diffuser,
	200 µl, 500 µl (standard size) and 1500 µl, packs of 50
Cell chambers	Cell chamber with membrane, complete with silicone-coated petri dish; pack of 10
DNA/RNA kits	Different types can be offered on request

UIS2 objectives for microdissection

Objective	NA	WD (mm)	Cover glass correction (mm)	Microdissection technique
LUCPLFLN20x (20x/PH; 20x/RC)	0.45	6.6–7.8	0–2	LCut, LAbl, LCH, LMan
LUCPLFLN40x (40x/PH; 40x/RC)	0.6	2.7–4	0–2	LCut, LAbl, LCH, LMan
LUCPLFLN60x (60x/PH)	0.7	1.5–2.2	0.1–1.3	LCut, LAbl, LCH, LMan
UPLFLN4x	0.13	17	-	Overview, navigation
UPLFLN10x	0.3	10	-	LCut, LAbl
UPLFLN20x	0.5	2.1	0.17	LCut, LAbl
UPLFLN40x	0.75	0.51	0.17	LCut, LAbl
UPLFLN40xO	1.3	0.2	0.17	LCut, LAbl, LMan,
UPLFLN60x	0.9	0.2	0.11–0.23	LCut, LAbl, LMan,
UPLFLN60xOI	0.65–1.25	0.12	0.17	LCut, LAbl, LMan
UPLFLN100xO	1.3	0.2	0.17	LCut, LAbl, LMan
UPLFLN100xOI	0.6–1.3	0.2	0.17	LCut, LAbl, LMan

LCut = laser cutting, LAbl = laser ablation, LCH = “live cell” handling, LMan = laser manipulation

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