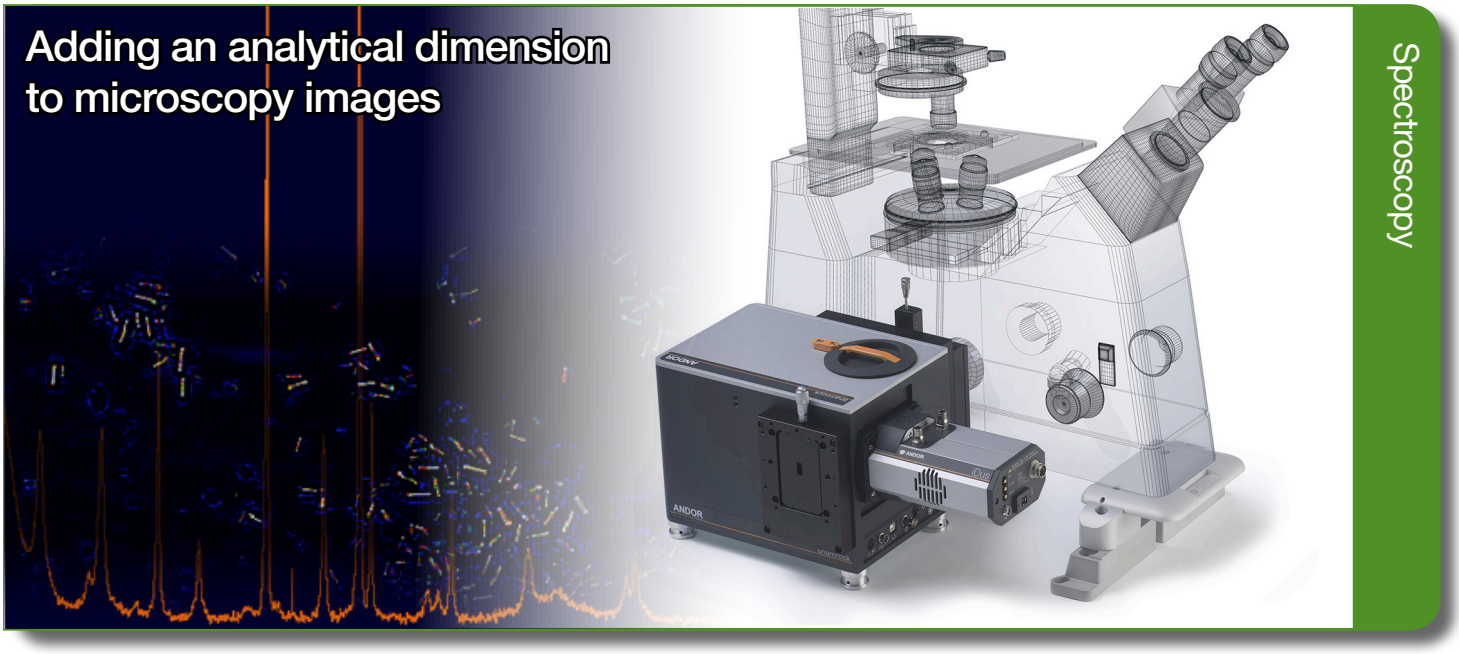
Modular Micro-spectroscopy Solutions

ANDOR
an Oxford Instruments company



Features and Benefits

- **High sensitivity detectors**
  Ultra-sensitive CCDs, ICCDs and EMCCDs cameras for maximum photon detection and speed.
  Ideal for fast and photon starved chemical mapping or microfluidics setups.
- **Highly configurable spectrograph platforms**
  Extensive range of multi-input & output, motorized Czerny-Turner spectrographs with seamlessly interchangeable and configurable accessories.
- **Seamlessly configurable spectrograph-microscope interfaces**
  - fibre optics
  - direct C-mount
  - 'cage' system
  - enclosed optical relay

  Dedicated feet sets allow easy optical height matching between spectrographs and inverted Nikon, Olympus, Zeiss & Leica microscopes.
- **Wide-aperture slit**
  Kymera and Shamrock input accessory for extended sample image relay AND spectral analysis through the same optical path.
- **µManager software integration**
  Simultaneous control of Andor cameras & spectrographs and a wide range of microscopes and accessories through a single software platform.
  Dedicated, user-friendly spectrum handling interface.
- **Software Development Kit (SDK)**
  Ease of control integration into custom, complex setups: Matlab, Labview, Visual Basic and C/C++ supported.

Highly configurable micro-spectroscopy interfaces

Andor's dedicated, highly configurable micro-spectroscopy interfaces allow seamless integration to microscopy systems. µManager's user-friendly control of the Kymera spectrographs and accessories provide a quick and easy setup of complex micro-spectroscopy acquisition sequences including chemical mapping. Wide-aperture slit options are also available for extended sample image relay and spectral analysis through the same optical path.

Key Applications

✓ **Micro-Raman**
- Surface-Enhanced Raman Scattering (SERS)
- Tip-Enhanced Raman Spectroscopy (TERS)
- Semiconductors & Graphene study

✓ **Micro-Luminescence / Photoluminescence / Fluorescence**
- Carbon nanotubes study
- Spectrally-resolved FRET
- Single Molecule spectroscopy
- Quantum Dots study
- Semiconductors study

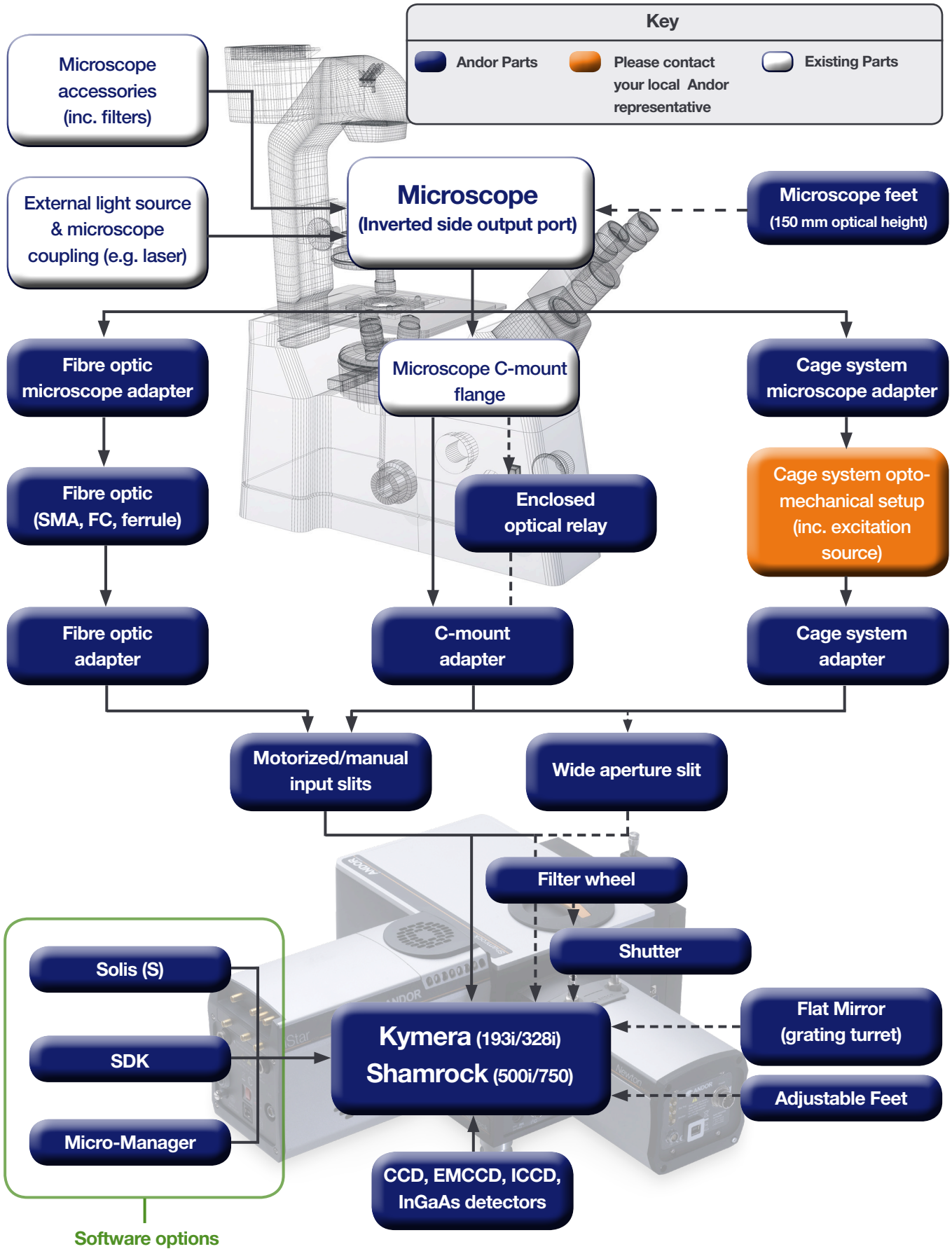
✓ **Plasmonic nanoparticle study**

✓ **Dark-field scattering spectroscopy**

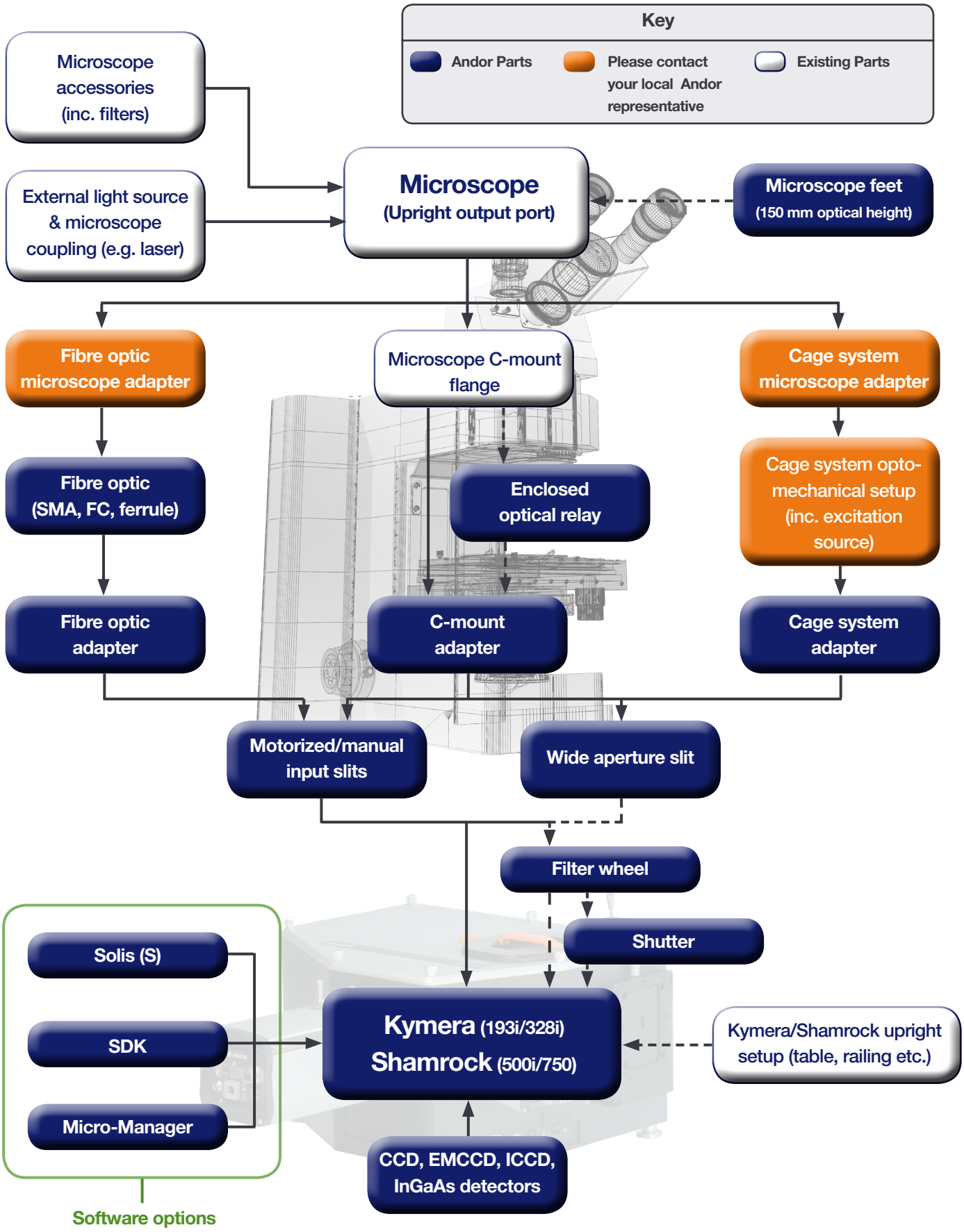
✓ **Spectrally-resolved microfluidics / flow cytometry**

✓ **Broadband transient spectroscopy**

INVERTED side microscope output – micro-spectroscopy options overview



UPRIGHT microscope output – micro-spectroscopy options overview



Spectrograph to microscope – key coupling considerations

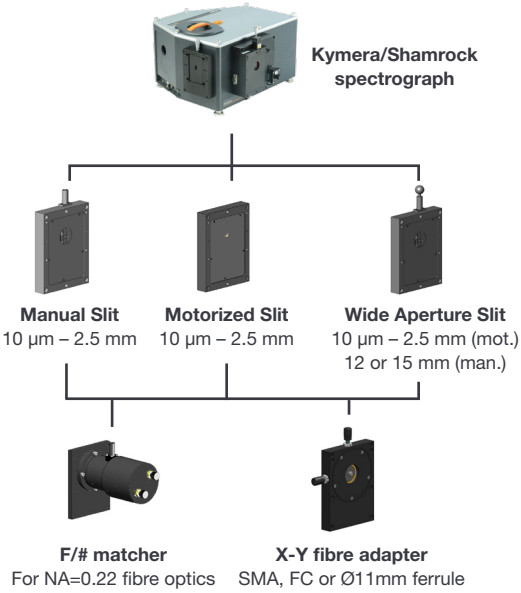
	Coupling interface		Optical height matching required?	Configur-ability	Light collection efficiency	Confocality	Microscope port connection	
	Microscope	Spectrograph					Side	Upright
Fibre optics	SMA or FC -to-C-mount adapter	X-Y fibre optic adapter (ferrule, SMA, or FC)	No	Limited - Choice of UV-VIS, VIN-NIR single or multicore fibres	Good	Low- dictated by fibre optic core size	Yes	Yes
Direct coupling	Standard 'male' C-mount adapter (infinity corrected)	C-mount adapter plate	Yes	-	Best	Lowest – collection from entire objective field of view	Yes	Yes*
Enclosed optical relay	Standard 'male' C-mount adapter (infinity corrected)	C-mount adapter plate	Yes	-	Good	Lowest – collection from entire objective field of view	Yes	Yes*
Cage system	Standard 'male' C-mount adapter OR free-space (infinity corrected)	30 mm cage adapter	Yes	Highest - User-defined, large range of 'cage' accessories	Dependant on user optical configuration	User setup-dependant - possibility of pinhole integration	Yes	Yes*

* Requires user to provide custom spectrograph positioning setup to accommodate this configuration

A Fibre optic coupling – interfacing to microscope upright & side port

Andor Kymera and Shamrock spectrographs offer a range of adjustable X-Y fibre optics input that can accommodate SMA, FC or Ø11 mm ferrule interfaces. F/# matchers allow maximum collection from NA=0.22 fibre optics assemblies for photon starved applications.

Andor fibre couplers → **Fibre optics** SMA-SMA, FC-FC or Ferrule to SMA/FC → **SMA/FC microscope adapters** Off-the-shelf side-port adapters can be found at www.Thorlabs.com



Part Code	Description
ACC-ME-OPT-8004	1 way fibre, single 50 µm core, UV/VIS, SMA-SMA
ACC-ME-OPT-8073	1 way fibre, single 200 µm core, UV/VIS, SMA-SMA
ACC-ME-OPT-8075	1 way fibre, single 100 µm core, UV/VIS, SMA-SMA
SR-OPT-8002	1 way fibre ferrule, 100 µm core, VIS/NIR
SR-OPT-8014	1 way fibre ferrule, 100 µm core, UV/VIS
SR-OPT-8019	1 way fibre ferrule, 200 µm core, VIS/NIR
SR-OPT-8024	1 way fibre ferrule, 200 µm core, UV/VIS,

Microscope	Microscope side port connection (Thorlabs references)		
Olympus IX71/81 & 73/83	SM1A51	+	SM1FC (FC adapter)
Leica DMI	SM1A50		SM1SMA (SMA adapter)
Nikon Eclipse Ti-E	SM1A44		

More fibre optics options at:
andor.com/spectrographs **(Accessories section)**

B Opto-mechanical coupling - interfacing to microscope side port

1 Microscope & spectrographs feet sets

Free-space optical coupling or **'hard' opto-mechanical coupling** between Kymera or Shamrock spectrographs and microscope side output ports require optical axis height matching. Andor offers a range of fixed, rugged microscope feet and adjustable spectrograph feet to allow perfect alignment between micro-spectroscopy system components at an optical height of 150 mm.

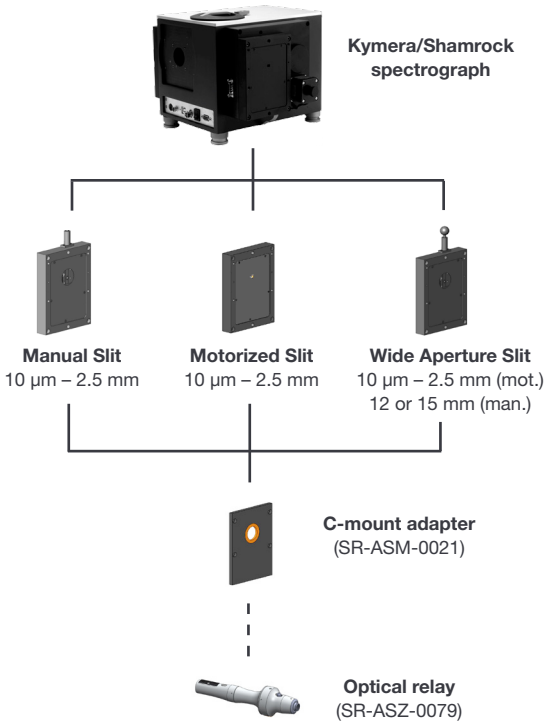
Microscope	Microscope fixed feet set
Leica DMI 4000/6000B	TR-LCDM-MNT-150
Leica DMi 8	TR-DMI8-MNT-150
Nikon Eclipse Ti (*not Ti2*)	TR-NKTI-MNT-150
Nikon Eclipse Ti2	TR-NKTI2-MNT-150
Nikon TE-2000	TR-NKTE-MNT-150
Olympus IX71/81 (left port)	TR-OLIX-MNT-150-LP
Olympus IX73/83 (left port)	TR-OL83-MNT-150-LP
Zeiss Axiovert 200	TR-ZSAV-MNT-150
Zeiss Axio Observer	TR-ZAXO-MNT-150

	Nominal optical height	Optical height adjustment range	Adjustable feet set
Kymera 193i	130 mm	130 – 136 mm (standard feet)	SR-ASM-0098: 6 mm spacer set*
Kymera 328i	142.6 mm	142.6 – 148.6 mm (standard feet)	SR-ASM-0098: 6 mm spacer set
Shamrock 500i / 750	146 mm	146 – 157 mm (using optional adjustable feet)	SR-ASM-0082

(*) 3 sets are required to accommodate microscope 150 mm optical height

2 Direct C-mount coupling

Kymera/Shamrock 'female' C-mount is directly coupled to specific microscope C-mount 'male' – provides the best light collection efficiency at the expense of confocality.



3 Enclosed optical relay

Direct mechanical coupling between a spectrograph and a microscope is the ideal configuration from an optical efficiency point-of-view. However, in case of physical interference between both instruments footprint, or the presence of an incubator around the microscope, an optical extender might be required.

Andor's optical extender '4f' configuration accommodates collimated and pseudo-collimated beam from the microscope, delivering uncompromising image relay performance to the Kymera/Shamrock spectrograph input aperture.

Feature	Details and Specification
Microscope interface	C-mount (female)
Spectrograph interface	C-mount (male)
Focal plane size	20 x 20 mm
Lens clear aperture	Ø 25 mm
Lens material	Fused silica, 400 – 1,000 nm (**)
Magnification	1:1 (horizontal & vertical)
Distortion	< 13 µm smile / barrel over focal plane 20 x 20 mm
Overall length	375 mm

(**) For alternative wavelength range, please contact your regional sale representative

4 Cage system adapter

Provides a highly modular, seamlessly upgradable and expandable platform for micro-spectroscopy setups. Andor Kymera/Shamrock spectrograph-to-microscope cage adapters are compatible with Thorlabs and Edmund Optics large range of 30 mm (*) cage system opto-mechanical accessories.

(*) For different size, please contact your local Andor representative

Wide range of opto-mechanical assemblies available:

- ✓ Ø 25 mm X-Y-Z-tilt lens or filter holders
- ✓ SMA/FC fibre connectors
- ✓ Beamsplitter and prism holders
- ✓ Pinhole holders
- ✓ Polarizer holders
- ✓ Iris and iris mounts
- ✓ Alignment targets

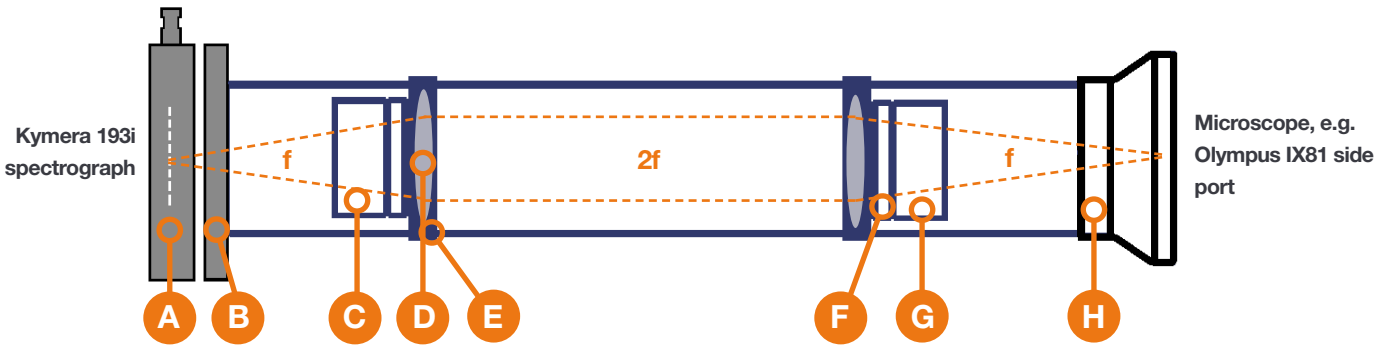
Andor offers a range of 30 mm cage to microscope adapters:

Microscope	Microscope to cage system adapter
Leica DMI 4000/6000B	TR-LCDM-CAGE-ADP
Leica DMi 8	TR-DMI8-CAGE-ADP
Nikon Eclipse Ti-series	TR-NKTI-CAGE-ADP
Nikon TE-2000	TR-NKTE-CAGE-ADP
Olympus IX71/81 (left port)	TR-OLIX-CAGE-ADP
Olympus IX73/83	TR-OL83-CAGE-ADP
Zeiss Axiovert 200	TR-ZSAV-CAGE-ADP
Zeiss Axio Observer	TR-ZAXO-CAGE-ADP

Generic 30 mm cage adapter	SR-ASM-0065

Example Configuration – '4F' optical relay lens

	Description	Part Code	#	Supplier
A	Kymera 193i, 15 mm wide-aperture slit	SR-ASZ-0086	x1	Andor
B	30 mm cage adapter	SR-ASM-0065	x1	Andor
C	30 mm cage rods 12" length 3" length 1" length 0.5" length	 ER12 ER3 ER1 * ER05 *	 x4 x4 x4 x4	Thorlabs
D	Ø25 mm lens, VIS-NIR achromatic	NT49374-INK	x2	Edmund Optics
E	XY lens holder, Ø25 mm	CXY1	x2	Thorlabs
F	Thread adapter for lens tube	SM1A16	x2	Thorlabs
G	Lens Tubes, Ø30 mm	SM30L10	x2	Thorlabs
H	Olympus IX81 cage adapter	TR-OLIX-CAGE-ADP	x1	Andor



5 Wide Aperture Slit - Combining sample imaging & spectral analysis through the same optical path

'Infinity-corrected' microscope ports exhibit quasi-collimated output beam with F/number typically > F/20. When this beam is relayed at the entrance slit of an 'imaging-corrected' spectrograph through direct coupling or low magnification optical arrangement, high fidelity images of the sample under the microscope objective can be acquired.

Step 1: Sample image visualisation

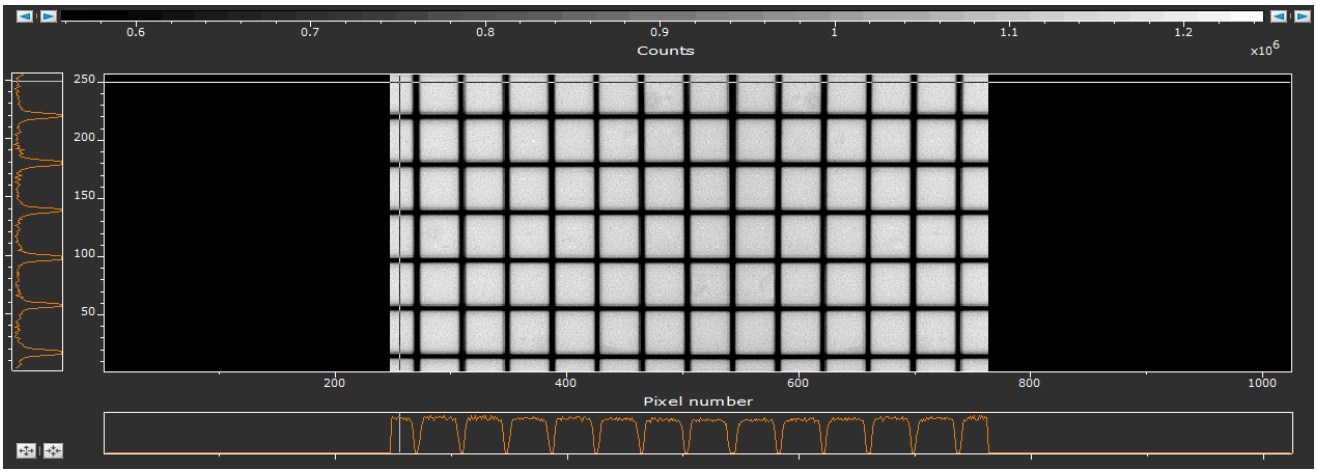
- ✓ Spectrograph input slits are opened widely
- ✓ Grating (or flat mirror) is positioned at the 'zero' order, reflecting the un-dispersed image of the sample
- ✓ Sample images are acquired by a camera at the output port of the spectrograph

Step 2: Sample positioning

- ✓ The image of the sample area of interest is positioned in the middle of the spectrograph input slit (by moving the microscope X-Y stage)

Step 3: Spectral acquisition

- ✓ Spectrograph input slits are closed to a few 10's of µm
- ✓ Grating is rotated to allow access to the desired wavelength range
- ✓ Spectral information from the sample can be acquired with the detector operating in vertical binning of multi-track mode



Above: High fidelity image of at a 25 µm pitch grid pattern on a microscope slide

Microscope: Olympus IX81 with x40 objective (N.A. 0.55) and wide-field illumination.

Detection: Kymera 193i directly coupled to the microscope side port, with a 15 mm wide-aperture slit, a grating at the 'zero' order and an iDus 420 CCD camera.

Kymera/Shamrock spectrograph

Grating turret and flat mirror options

Wide Aperture Slit
10 µm – 2.5 mm (mot.)
12 or 15 mm (man.)

Part Code	Description
SR-ASZ-0086	Wide-aperture entrance slit, motorised from 10 µm to 2.5 mm, manual up to 15 mm
SRx-GRT-yyyy-zzz	Grating options Please refer to individual spectrograph specification sheets at andor.com/spectrographs
SRx-GRT-MR-AL+MGF2	Flat mirror option, MgF_2-protected aluminium, broadband UV-VIS-IR Please refer to spectrograph specification sheets for efficiency curves at andor.com/spectrographs
SRx-GRT-MR-SIL	Flat mirror options, silver-protected, highest efficiency in the VIS-IR Please refer to spectrograph specification sheets for efficiency curves at andor.com/spectrographs

C Research-grade spectrographs for Micro-spectroscopy

Highly modular motorized platforms with dual output ports, dual/triple grating turret and wide range of motorized and field upgradable accessories

Kymera 193i – Compact 193 mm imaging Czerny-Turner spectrograph with Active Focus technology – ideal for lower spectral resolution applications.

Shamrock 500i/750 – Ideal for more demanding, high and higher spectral resolution applications.

Kymera 328i – Highly configurable platform, with advanced user controls to always access the very best spectral performance for routine measurements or more demanding optical setups.

Learn more about the Andor spectrograph range and accessories at andor.com/spectrographs

	Grating (l/mm)					
	150	300	600	1200	1800 (Holo)	2400 (Holo)
Kymera 193i						
Bandpass (nm)*1,*3	902	445	215	98	56	46*4
Resolution (nm)*2,*3	1.96	0.96	0.47	0.21	0.12	0.10*4
NEW Kymera 328i						
Bandpass (nm)*1,*3	542	268	131	61	41	29*4
Resolution (nm)*2,*3,*5	0.88→0.62	0.44→0.31	0.21→0.15	0.10→0.07	0.06→0.05	0.05→0.04*4
Shamrock 500i						
Bandpass (nm)*1,*3	357	177	86	40	26	19*4
Resolution (nm)*2,*3	0.52	0.26	0.13	0.06	0.04	0.03*4
Shamrock 750						
Bandpass (nm)*3,*5	242	120	59	28	18	14*4
Resolution (nm)*4,*5	0.35	0.18	0.09	0.04	0.03	0.02*4

Looking for higher optical throughput?

The Andor HoloSpec is a high throughput transmission spectrograph with a robust, compact, low stray-light design ideal for photon-starved, fibre-coupled setups

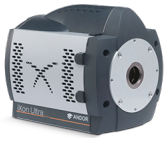
D Market leading detectors for Micro-spectroscopy

Best matching requirements for sensitivity at wavelengths of interest, acquisition speed and time-resolution.

iDus 416 'low-dark current deep-depletion' (LDC-DD) CCD – Superior near-IR detection with up to 95% QE at 800 nm.

iDus & Newton 'Dual AR CCD' (BEX2-DD) – Market leading broadband detection with >90% QE from 400 to 850 nm.

Newton^{EM} and iXon Ultra EMCCD – Unmatched sensitivity in the UV-visible range, superfast kHz acquisition capabilities, single photon sensitive.

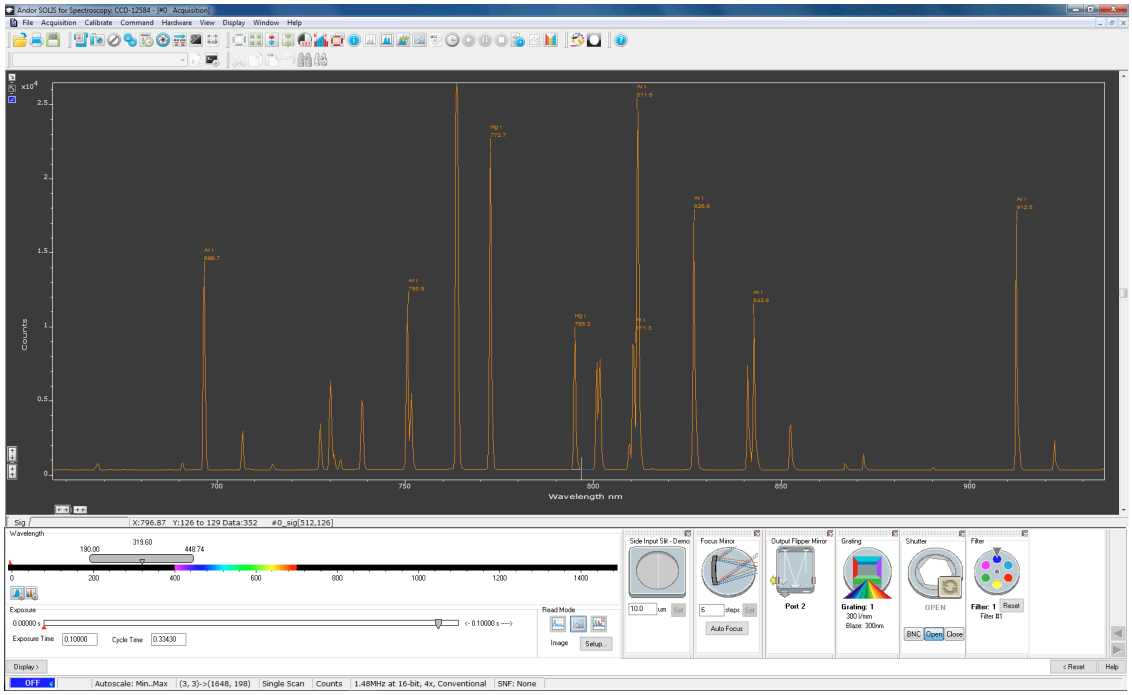


iStar ICCD – Nanosecond-gated detector for characterizing fast transient phenomena.

Learn more about Andor detectors range at andor.com/scientific-cameras

E Software solutions

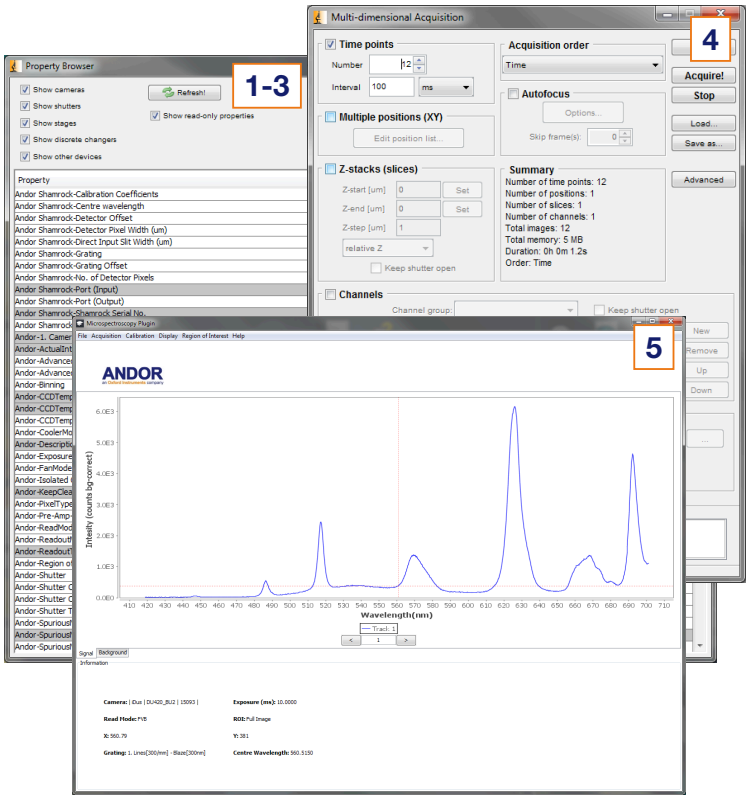
Solis Spectroscopy A 32-bit and fully 64-bit enabled application for Windows (7, 8, 8.1 and 10) offering rich functionality for data acquisition and processing, as well as Andor cameras, spectrograph and motorized accessories simultaneous control. AndorBasic provides macro language control of data acquisition, processing, display and export.



Kymera/Shamrock SDK A software development kit that allows you to control the Andor range of Kymera/Shamrock spectrographs from your own application. Compatible as 32-bit and 64-bit libraries for Windows (7, 8, 8.1 and 10). Compatible with C/C++, C#, VBNet and LabVIEW and Linux.

µManager Integrated modular micro-spectroscopy setup control popular with the Life Science community. All market leading motorized microscope & accessories seamlessly controlled and maintained. Integrated sequence builder & macro interfaces for complex experiments building.

Dedicated spectra display & processing interface plug-in, available through MyAndor.



5 steps to set up your micro-spectroscopy experiment

1. Set up spectrograph
2. Set up camera
3. Set up microscope
4. Set up experiment e.g. X-Y-Z chemical mapping
5. Display spectral data in real time & save acquisition series

Order Today

Need more information? At Andor we are committed to finding the correct solution for you. With a dedicated team of technical advisors, we are able to offer you one-to-one guidance and technical support on all Andor products. For a full listing of our local sales offices, please see: andor.com/contact

Our regional headquarters are:

Europe
Belfast, Northern Ireland
Phone +44 (28) 9023 7126
Fax +44 (28) 9031 0792

North America
Concord, MA, USA
Phone +1 (860) 290 9211
Fax +1 (860) 290 9566

Japan
Tokyo
Phone +81 (3) 6732 8968
Fax +81 (3) 6732 8939

China
Beijing
Phone +86 (10) 8271 9066
Fax +86 (10) 8271 9055

Footnotes: **Specifications are subject to change without notice**

1. Typical values quoted with 27.6 mm wide CCD, e.g. Newton DU940.
2. Typical values quoted with 10 µm slit and 13.5 µm pixel CCD, e.g. Newton DU940.
3. Typical values quoted at 500 nm centre wavelength.
4. Typical values quoted at 300 nm centre wavelength.
5. With TrueRes™ option.