Microscopy from Carl Zeiss

AxioCam MRm
Pure Sensitivity

The New Standard for
Digital Fluorescence Imaging

ZEISS

We make it visible.

AxioCam MRm from Carl Zeiss – More Information at Low Light Intensities

More than ever before, modern research is looking towards the most sophisticated methods in fluorescence microscopy in order to make new discoveries in medicine and biology. Whether the technique is FISH, FRET, FRAP or multichannel imaging, digital fluorescence imaging always demands an extremely powerful camera with maximum sensitivity and minimal noise. Carl Zeiss has developed the AxioCam MRm monochrome digital camera specifically to meet the complex requirements of high-end research.

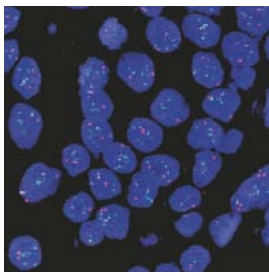
- **High dynamic range of more than 1 : 2200**
- **Outstanding sensitivity**
- **Variable exposure time ranging from 1 ms to 60 seconds**
- **Up to 48 images per second**
- **Rapid acquisition modes for time lapse**

High performance down to the last detail and an impressive range of functions – the AxioCam MRm offers an unparalleled spectrum of applications. This highly sensitive, easy-to-use camera turns your microscope into an attractively priced, high-end system for fluorescence imaging.

The visible difference: maximum sensitivity for weak fluorescence

High performance right down to the smallest detail: all the components of the AxioCam MRm have been specially designed for use under difficult lighting conditions.

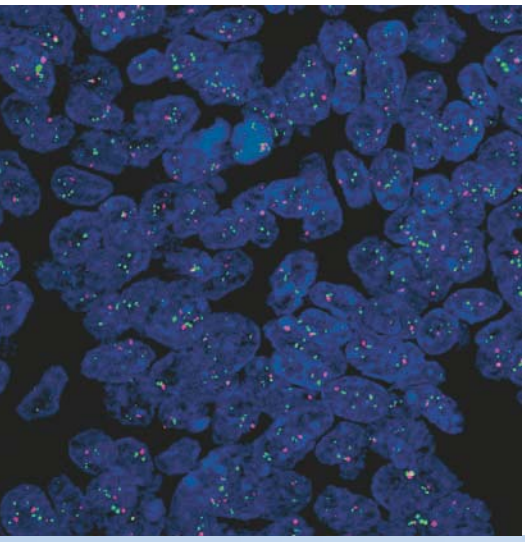
- The 2/3" sized CCD sensor which is not equipped with a color filter mask can acquire fluorescences that are even invisible to the human eye. The sensor is Peltier-cooled and delivers low-noise images, even with long exposure times – in flexible resolutions up to 1388 x 1040 pixels.



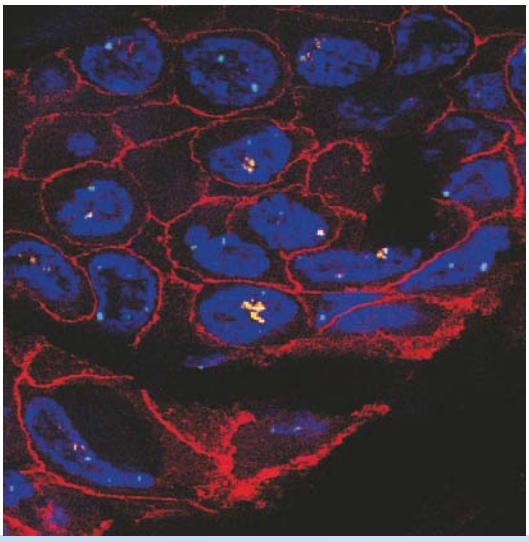
The AxioCam MRm in multiparametric FISH analysis

Fluorescence-In-Situ-Hybridization (FISH) is a significant additional detection method in modern tumor diagnostics. As part of this technique, fluorescent, sequence-specific nucleic acid probes interact with specific loci. This allows statements to be made about the translocations, amplifications or deletions of certain gene sections. Within the context of a newly established multiparametric FISH analysis (Lottner et al, 2005), the combined application of probes from the FISH technique is used with protein-binding antibodies. The fluorescence signals acquired with this technique are then overlaid and displayed in the software. Using this method, diagnoses made immunohistologically at protein level can also be checked and consolidated at cytogenetic level.

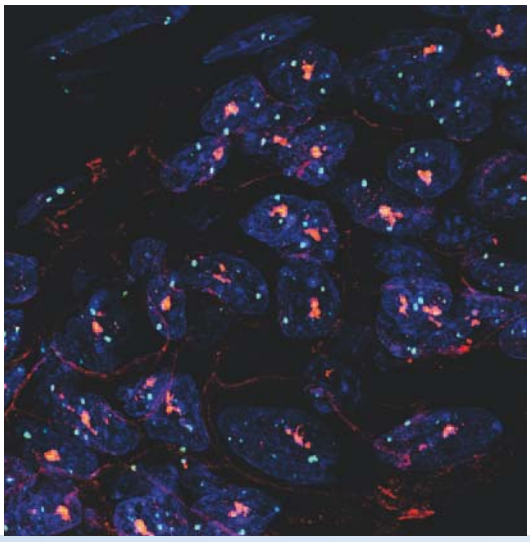
Together with the AxioVision imaging software and ApoTome, the AxioCam MRm delivers highly resolved optical sections for this application – by means of the push of a single button – quick and uncomplicated.



Detection of the human HER2/neu gene (green) and centromere (red) on chromosome 17 by means of Fluorescence-In-Situ-Hybridization (FISH) in mammary tumor tissue using probes from ZytoVision GmbH, Bremerhaven

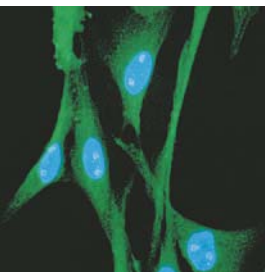


Section from a three-dimensional Z-stack: simultaneous display of HER2/neu gene and centromere signals (ZytoVision GmbH) using the FISH method and protein expression of the HER2/neu receptor (DakoCytomation) with the help of fluorescent immunohistochemistry (FIHC)



Overlaid display of 22 z-positions in maximum projection using AxioVision and the Multichannel Fluorescence and Z-Stack modules

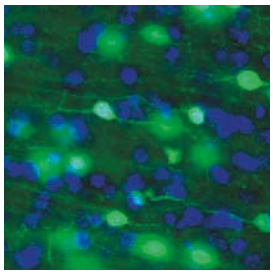
Images with kind permission of the Brockhoff working group, Institute of Pathology, University of Regensburg, Germany



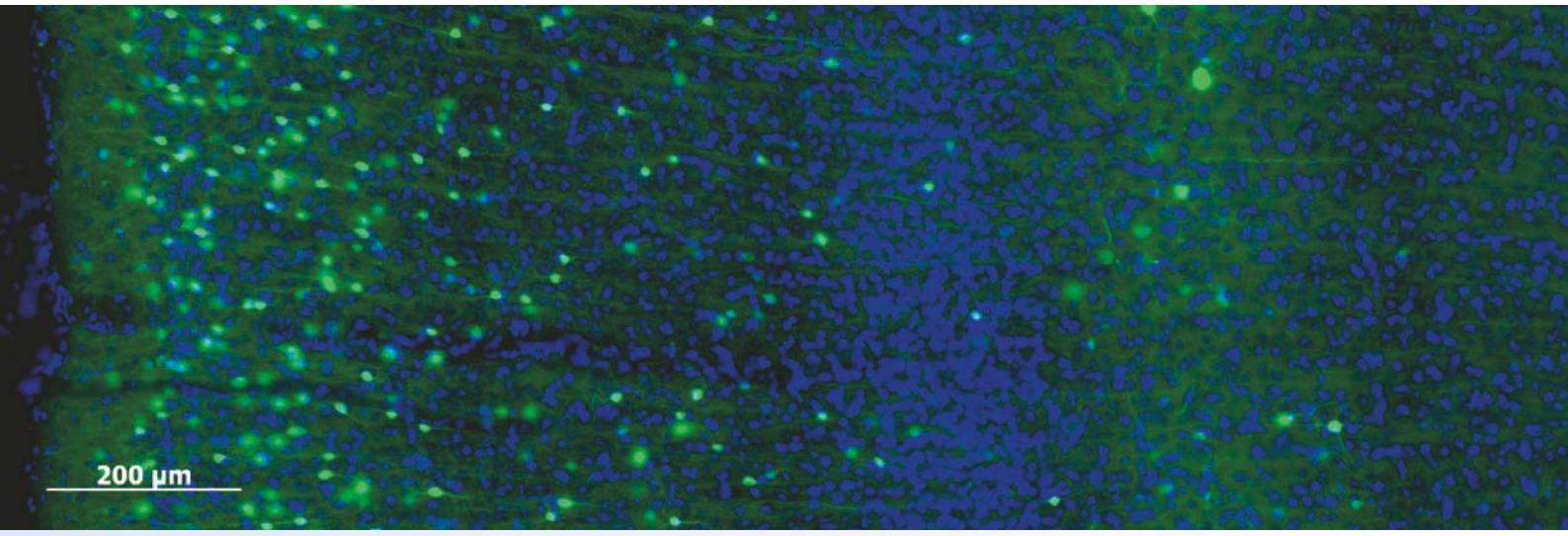
Applications

AxioCam MRm in clinical neurobiology

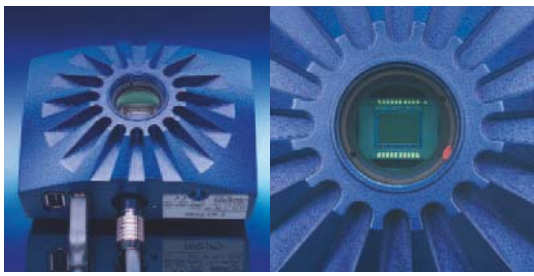
Developing new therapeutic approaches for stress-related illnesses in humans is another significant research task. It has been found that long-term psychosocial stresses influence the structure and function of the central nervous system in humans as well as in apes. Typical stress-related clinical pictures such as depression can therefore also be detected in animals on the basis of the morphological changes in the affected areas. One method used in this area is the analysis of the neuronal cell morphology and tissue structures in the neo and cerebral cortex of Callithrix jacchus, a new world primate. This analysis provides basic neurobiological research with important insights into the background and triggers of these illnesses. Using the AxioCam MRm and AxioVision MosaiX software module, the large tissue sections needed can be acquired and precise analyzed in several fluorescence channels.



Cortex region of Callithrix jacchus
Selective magnification



MosaiX image of the cortex region of Callithrix jacchus (new world monkey)
Double fluorescence with specific labeling of calretinin (green) and cell nuclei (blue)
Images with kind permission of Eberhard Fuchs, Boldizár Czéh and Susanne Bauch, German Primate Center, Göttingen, Germany



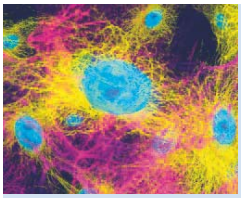
- The dynamic range of more than 1 : 2200 makes the finest differences in brightness visible and, consequently, makes reliable interpretation possible.
- The very low background noise produced by the camera electronics allows extremely weak signals to be detected.
- Using the RGB filter inserts (available as an option), it is even possible to acquire color images on a fluorescence microscope.
- The AxioVision imaging software is geared perfectly to the performance of the AxioCam MRm. This means that even demanding multichannel fluorescence images can be acquired quickly and easily. Modern image enhancement techniques, such as deconvolution, make the images even more meaningful.

More speed: capture dynamic processes faster

The AxioCam MRm improves the performance of imaging systems for multidimensional image acquisition even further.

- For particularly fast multichannel imaging, up to five exposure times can be stored in the camera head and called up immediately.
- The 400 megabit, fast FireWire connection transfers the images directly to your PC or notebook.
- In the Continuous Mode, rapid, continuous acquisition of dynamic processes is possible. The overlapping exposure and readout of the sensor allows rapid time lapse imaging at perfectly even and closely staggered intervals.

You want to	The AxioCam MRm offers
• quantify the intensity changes of fluorochromes even when there are strong differences in image brightness	• excellent dynamic range of more than 1 : 2200 with 12 bit gray level display
• focus and navigate conveniently even when using long exposure times	• a live image (with focusing aid) that is updated up to 32 times per second
• acquire extremely weak fluorescence signals	• variable exposure duration of 1 ms up to 60 seconds
• obtain high-contrast images without disruptive image noise	• active dark current compensation and Peltier cooling
• use as little excitation light as possible and minimize the stress on the specimen	• a 2/3" CCD sensor with 6.45 x 6.45 µm sized pixels and no light-reducing color filter mask
• analyze fluorescence emissions from 700 nm	• a NIR mode for increased sensitivity in the near infrared
• document rapid physiological processes	• a mode for the rapid, continuous acquisition of images
• work with a camera that can be operated flexibly and simply using a PC or notebook	• IEEE 1394a FireWire interface with integrated power supply via a single cable

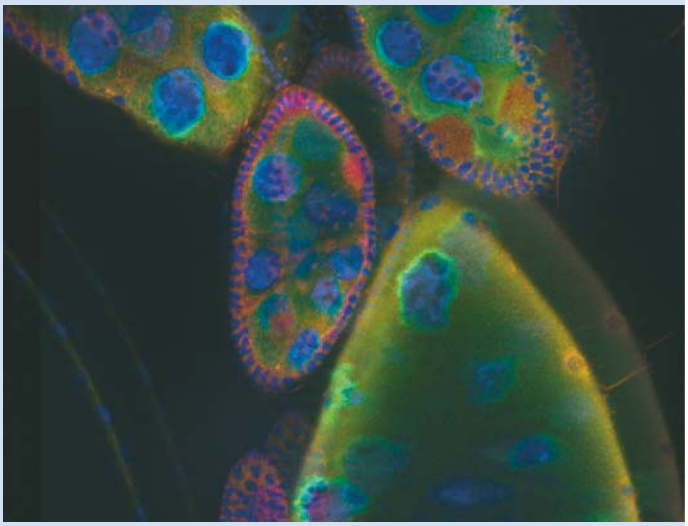


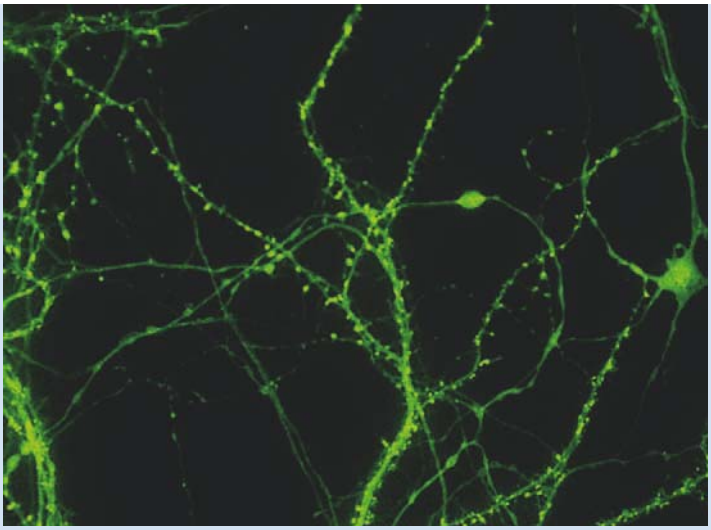
Carl Zeiss: FluoresScience

Fluorescence forms the basis for many modern methods used in the field of Life Sciences. Today, new, constantly modified and improved fluorescence applications enable us to monitor the molecular relationships inside cells. The demands on the corresponding microscope systems are also increasing.

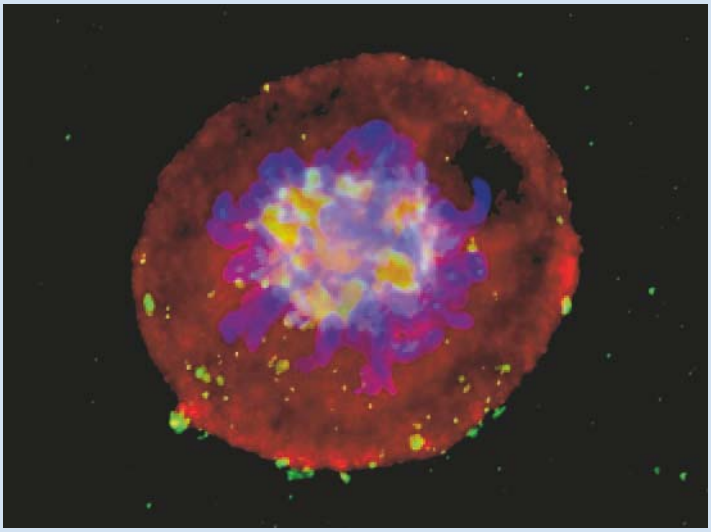
The development of these systems is an ongoing challenge. We at Carl Zeiss devote our full commitment and technical expertise to support this endeavor. When working at the limits of visibility, only the best will do. Carl Zeiss offers tools with optimum efficiency, the most innovative technologies, the most powerful imaging systems, and highly sensitive cameras for digital fluorescence imaging which are at the cutting edge of technology.

Our focus on the key method used for research of life has been given a name – Carl Zeiss: FluoresScience.

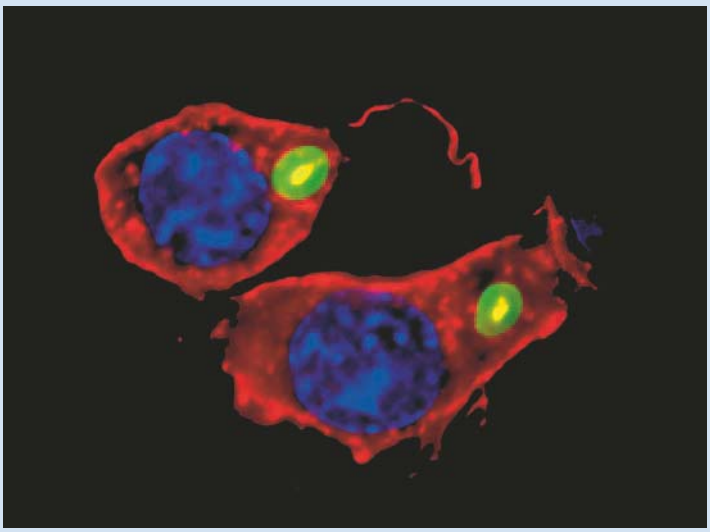




Neurones (green) in the hippocampus of a mouse
Prof. Okabe, Department of Cell Biology, Tokyo Medical University, Japan



pTK12 cell, mitotic phase: chromosomes (DAPI), spindle (FITC) and nucleoporins (Alexa 568)
Jessica Campbell, acquired during the FISH course, October 2005, Cold Spring Harbor, NY, USA



Macrophage with F-actin (phalloidin-Alexa 568) and nucleoli (DAPI) surrounded by S.aureus bacteria (green)
Dr. Horst Wolff, GSF Institute of Molecular Virology, Munich, Germany

Technical Data AxioCam MRm

Sensor	Sony ICX 285, progressive readout, without filter mask
CCD basic resolution	1388 x 1040 = 1.4 megapixels
Pixel size	6.45 µm (h) x 6.45 µm (v)
Sensor size	Chip area 8.9 mm x 6.7 mm, equivalent 2/3"
Spectral range	Approx. 350 nm-1000 nm, BK 7 protection glass without IR filter (IR filter BG 40 can be inserted)
NIR mode	Mode for higher sensitivity, especially for near IR
Dynamic range	Typical > 1 : 2200 (> 66.8 dB)
Full well	Typical 17 Ke
Readout noise	Typical < 7.7 e
Dark current	Typical 0.7 e/pixels/s, dark current compensation for maximum low light performance
Readout speed	24.57 MHz pixel clock

Live image frame rates	H	x	V	Mode / Binning	Max. frame rate*
	1388	x	1040	slow / 1	13 images/s
	692	x	520	middle / 2	23 images/s
	460	x	344	fast / 3	32 images/s

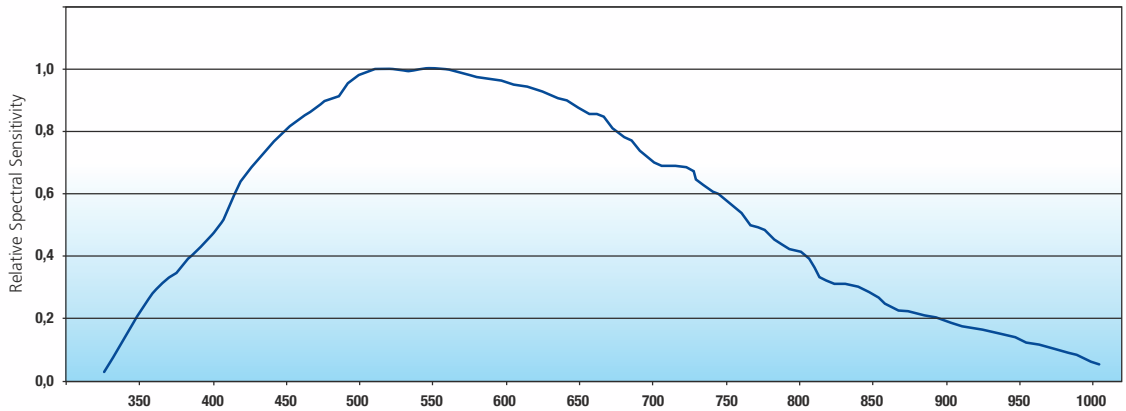
Resolution and frame rates for time lapse images in the AxioVision module Fast Acquisition	H	x	V	Binning	Max. frame rate*
	1388	x	1040	1 x 1	14 images/s
	692	x	520	2 x 2	26 images/s
	460	x	344	3 x 3	35 images/s
	344	x	260	4 x 4	43 images/s
	272	x	208	5 x 5	50 images/s

Max. file size per image	Approx. 2,8 MB at 1388 x 1040 at 12 bit
High speed operation modes for AxioVision module Fast Acquisition	• Five preloadable exposure time parameters in camera head for high-speed multichannel acquisition** • Continuous Mode for fast triggered acquisition • Overlapping exposure and readout of the sensor in fast time lapse images***
Hard dish recording	Inline recording of image data directly to hard disk at all speeds with AxioVision module Fast Acquisition
Readout of sub frames (ROI)	Freely selectable
Signal amplification	Analog: 2x, digital 32x
Digitization	12 bit
CCD cooling	One stage Peltier cooling
Interface	FireWire 1394a (400 megabit/s)
Range of integration time	1 ms up to 60 s
Signal output connectors	2 x TTL-Out: exposure time, readout time (i.e. for driving external electric shutters), 1 x Trigger-In to start an acquisition
Optical interface	C-Mount
Housing	Blue anodized aluminum, with cooling fins, 1/4" connection for tripod mount, 11 cm x 8 cm x 4.5 cm / 370 g
Operating systems	Microsoft® Windows 2000 Professional Microsoft® Windows XP Professional
Dual camera operation	Possible
Registration	CE, cUL
Power supply	10-33 V, DC, 4 W power supply provided by FireWire bus from PC (external power supply only for Notebook operation required)
Ambient condition (operation)	+5° ... +35° Celsius, max. 80% relative humidity, no condensation, free air circulation required
Order number	426509-9901-000

Above frame rates are supported by the camera electronics. Computer hardware, operating system and application software may decrease the frame rates. Selecting a part of the sensor area can increase the frame rate. All specifications are subject to change without notice.

*Frame rates depend on exposure time and readout mode.
**In Continuous Mode the maximal exposure time is 819 ms per channel.
***In basic resolution mode the sensor readout time is 69 ms. Below this value, the frame rate is only determined by readout time. Above this value, the frame rate is determined by exposure time, only. With activated binning mode, the readout time is shorter, respectively.

Relative Spectral Sensitivity



Maximum value equals approx. 65% quantum effectiveness

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