

UNIVERSAL 5.3 MEGAPIXEL BOTTOM-MOUNTED TEM CCD CAMERA

Tengra is EMSIS’ newest 5.3 MegaPixel TEM CCD bottom-mounted on-axis camera. This state-of-the-art camera offers a great-value solution for all standard TEM image acquisition applications with a strong focus on materials sciences. Tengra combines a large, sensitive CCD chip with attractively high readout speed, tapered fiber optics and a perfectly matched phosphor scintillator, to meet the highest quality demands.

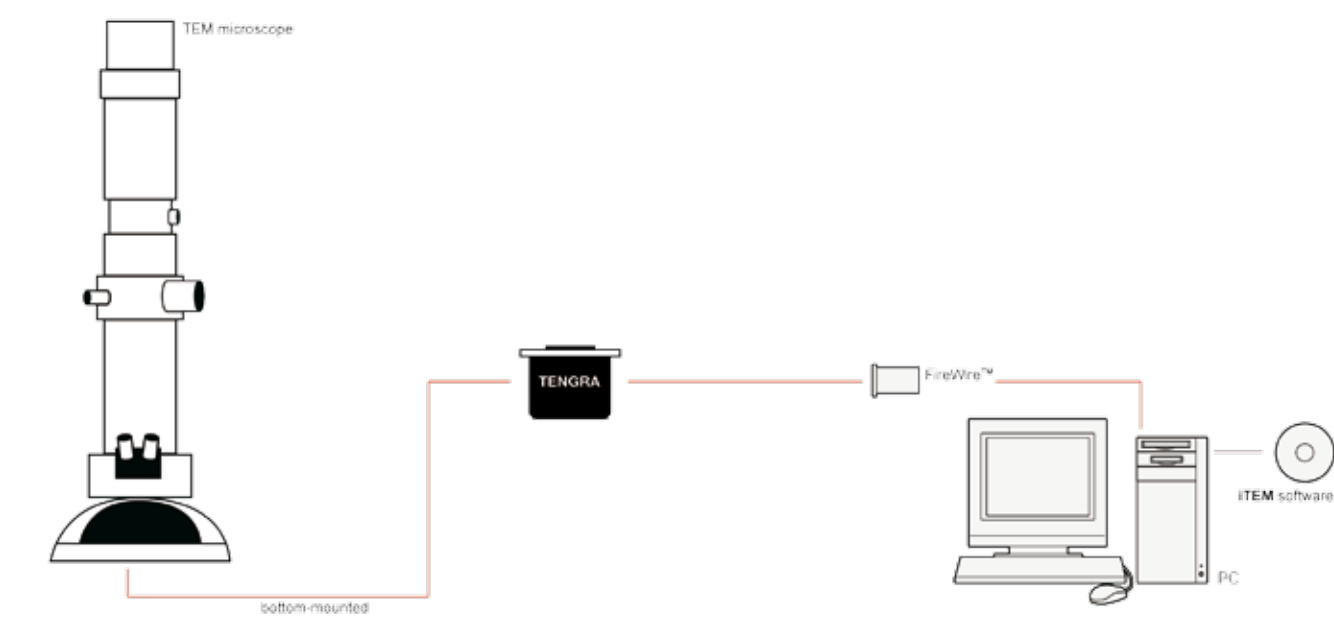
IMAGING SOLUTIONS FOR ELECTRON MICROSCOPY. BASED ON OPTO-DIGITAL KNOW-HOW. DESIGNED BY CUSTOMER REQUIREMENTS.



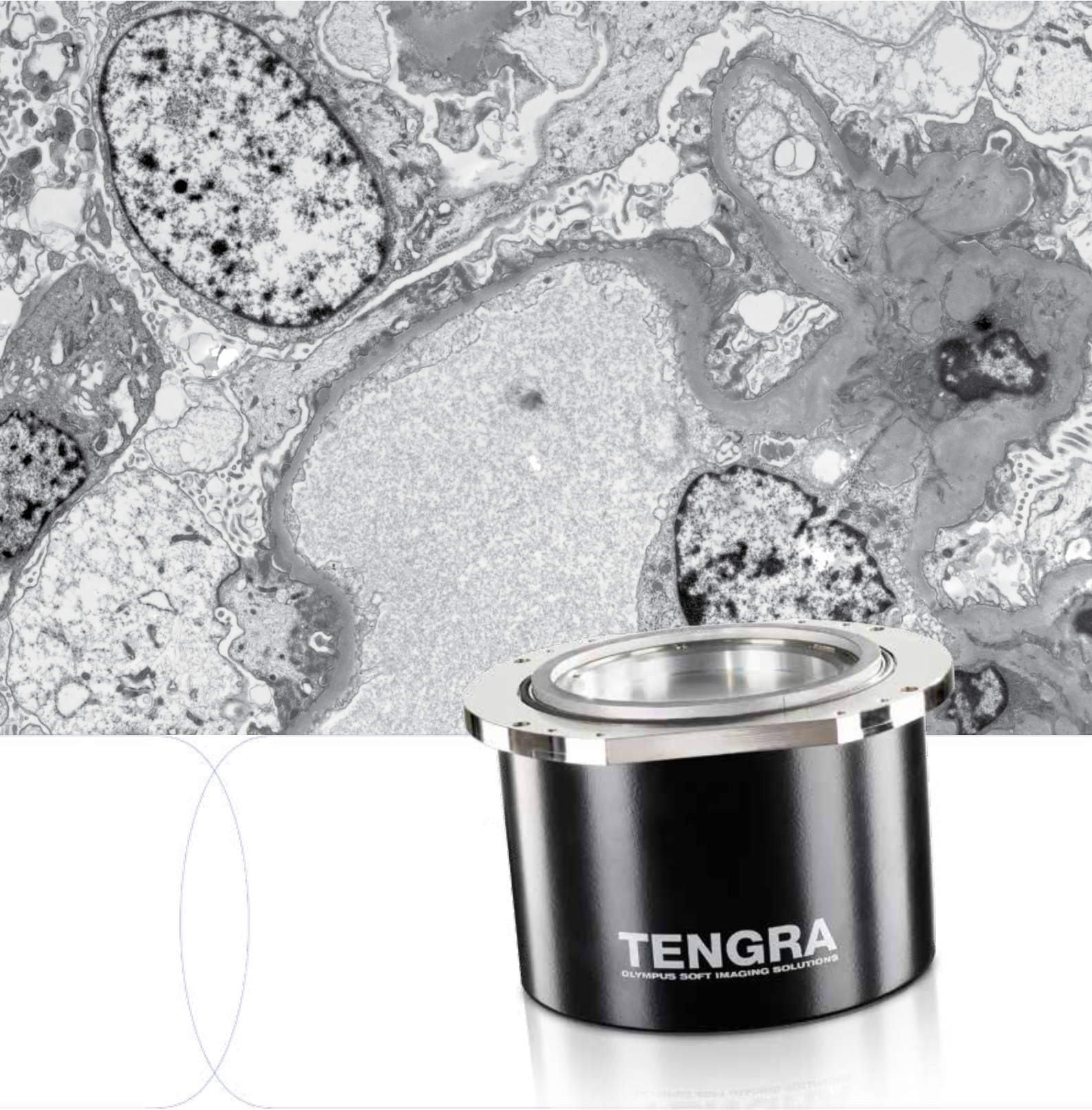
Specifications

| H TENGRA                             |   |
|--------------------------------------|---|
| Chip type                            | Interline CCD image sensor  |
| Resolution (pixels)                  | 2304 x 2304   |
| Binning 2x (pixels)                  | 1152 x 1152   |
| Effective pixel size (µm²)           | 18.0 x 18.0   |
| Field of View (mm²) / depends on TEM | 41.0 x 41.0   |
| Binning                              | 2x, 3x and 4x   |
| Frame rate (fps)                     |   |
| @ full resolution                    | > 2 (HQ mode)   |
| @ binning 2                          | > 8   |
| @ binning 4                          | >12   |
| Digitization (bits)                  | 14  |
| Exposure time                        | 1 ms - 100 s  |
| Display                              | Full image in real time   |
| Camera mount                         | Bottom port   |
| Anti-blooming                        | > 100x  |
| PC interface                         | FireWire™ (IEEE 1394a)  |
| Camera coupling                      | Fiber optics (2:1)  |
| Partial readout                      | Yes   |
| Full well capacity (e-)              | > 60000   |
| Scintillator                         | High quality phosphor optimized for accelerating voltage 100 kV or 200 kV |
| CE certified                         | Yes   |
| RoHS compliant                       | Yes   |
| APPLICATIONS                         |   |
| Materials Sciences                   |   |
| Diffraction                          |   |
| Particle and object analysis         |   |
| Life Sciences                        |   |
| Digital documentation                |   |

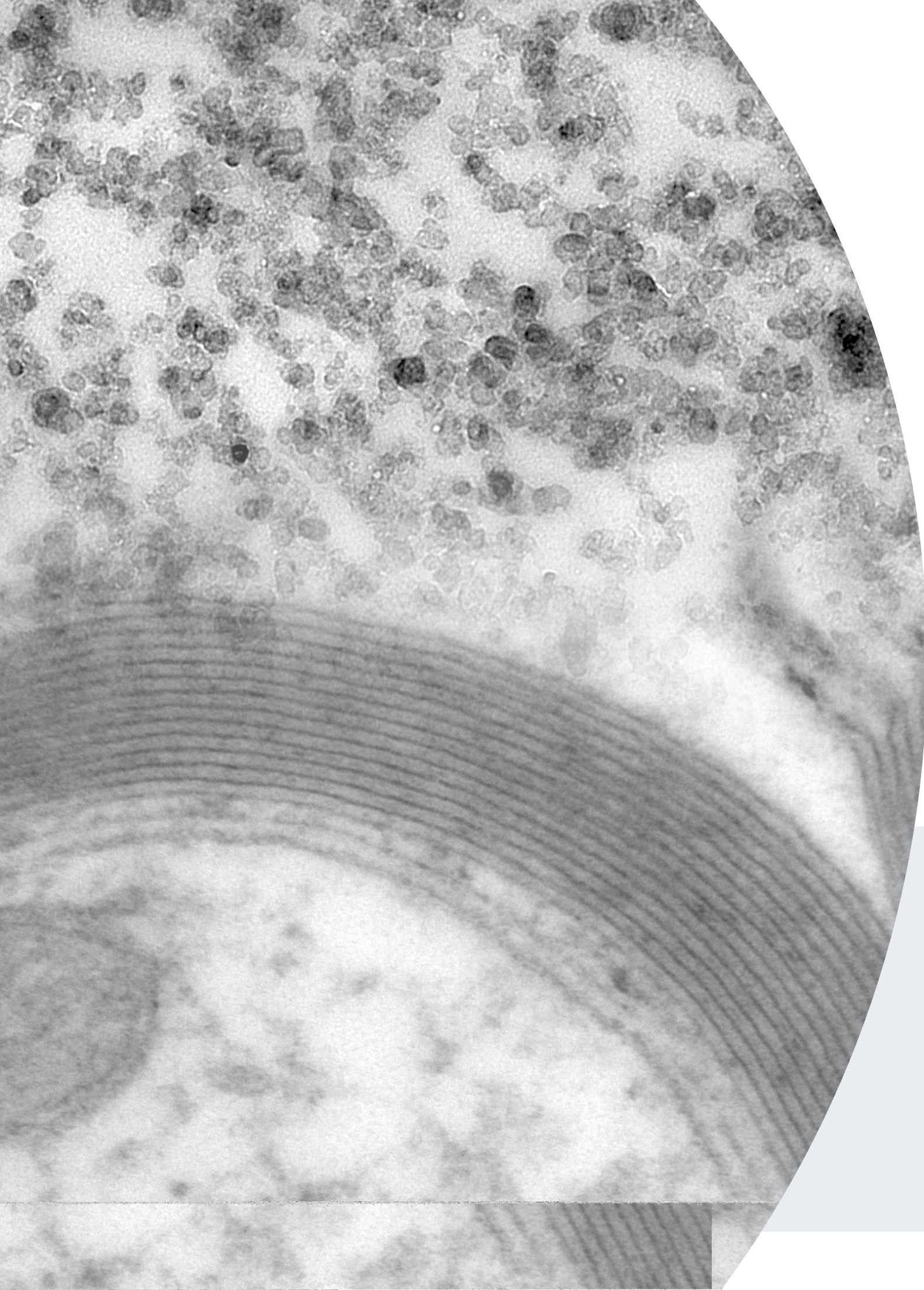
System Diagram



An advanced imaging system for routine and demanding TEM analysis







# BASED ON OPTICAL EXPERTISE AND LONG-STANDING EXPERIENCE IN TEM CAMERA DEVELOPMENT

## Extraordinary Resolution

Images delivering high contrast, high sensitivity and superior resolution – such a combination of advantages is the goal of most TEM users, whether novice or experts; whether for the most routine or the most demanding of TEM analyses. The Tengra camera system does this superbly with its 2:1 fiber-optic taper, which increases the effective pixel size to 18  $\mu\text{m}$  x 18  $\mu\text{m}$ , so ideally matching scintillator thickness and pixel size and ensuring that the maximum number of photons are detected. This highly efficient conversion of primary electrons in the scintillator combined with optimized electronic design delivers a near perfect signal-to-noise ratio, resulting in an outstanding image with optimal resolution and high sensitivity. Even the finest details are reproduced perfectly in the camera image.

## Low Noise

Cooling is a prerequisite for low noise and high dynamic range. A Peltier cooling minimizes the CCD dark current of the Tengra camera system and stabilizes the system at a temperature of 20 °C. A well capacity of over 60,000 electrons results in an efficient 14-bit dynamic range and a perfect signal-to-noise ratio, ensuring data precision for any imaging task. Built-in real-time functionality such as online shading correction and automatic gain control calculate the best possible contrast, showing all details within the image. The complete recording process improves acquisition performance, reliability and quality.

## Large Field of View

A large field of view is one of the basic prerequisites for many TEM materials science and life science imaging applications. Such applications often need to view and record images from sample areas larger than conventional photographic film. At the same time these applications need to navigate through the sample and zoom in to evaluate details such as small particles, viruses, etc. The interline CCD chip provides 2304 x 2304 pixel resolution resulting in a field of view of 41 mm x 41 mm, which enables the camera to offer a field of view corresponding approximately to the size of a conventional photo plate. Using the stitching functionality of our image acquisition platform iTEM, even larger images can be recorded with ease. Supreme image quality, instant viewing mode based on high frame rates, fast navigation tools and various saving options make the camera the complete solution for state-of-the-art TEM imaging.

## High Frame Rate Imaging

Advanced CCD technology with sophisticated electronics combined with high speed single-port read-out enables high speed performance. High frame rates offer astonishing capability for TEM in-situ observations of dynamic events in life science and materials science applications. Fast viewing modes allow the user to find sample areas of interest quickly and efficiently. And thanks to high frame rates, operations such as microscopy alignments and focusing are performed with high precision using the camera display instead of the TEM

# IMAGING EXCELLENCE WITH A LARGE FIELD OF VIEW, HIGH FRAME RATES AND LOW NOISE

viewing screen. The Tengra is a high-speed digital imaging solution supporting several binning modes as well as partial read-out. Using the binning mode increases frame rates and sensitivity. Capturing and streaming digital video directly from live images to observe dynamic events has been a basic element of the iTEM and RADIUS imaging platforms for years.

## Anti-blooming performance

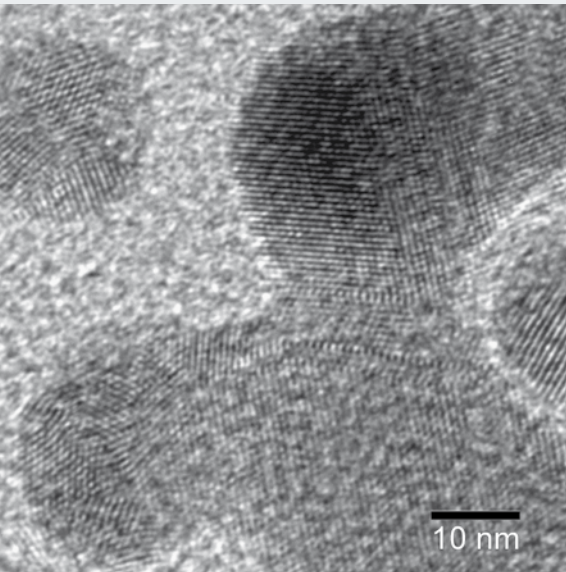
One of the most challenging tasks for CCD TEM cameras is viewing and recording electron diffraction patterns due to blooming effects or smearing artifacts resulting from intensive illumination or overexposure. Blooming can be described as a charge overflow to neighboring CCD pixels due to pixel saturation from high intensity diffraction spots, resulting in strong intensity streaks in the recorded diffraction pattern. The Tengra is an ideal solution for recording high resolution electron diffraction patterns. The high anti-blooming performance of the CCD sensor and advanced CCD electronic design make the recording of electron diffraction patterns without artifacts an easy and routine task. It guarantees optimum sensitivity and resolution for diffraction imaging.

## Software integration

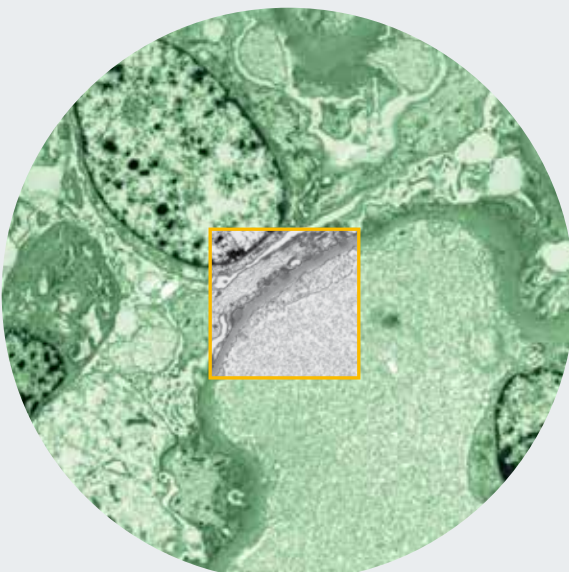
The Tengra is fully integrated with iTEM and RADIUS, our TEM imaging platform. iTEM and RADIUS sets a standard in attractively simple yet intuitive user control. All of our TEM cameras, as well as most remote-controlled TEMs and motorized stages, can be operated via this platform. Real-time functions such as automatic contrast enhancement ensure the best possible image capture quality. Within

iTEM and RADIUS, the acquired images can be processed, analyzed, archived and documented. Software add-ons tailored to your applications make it easy to increase the range of functionality offered by iTEM and RADIUS.

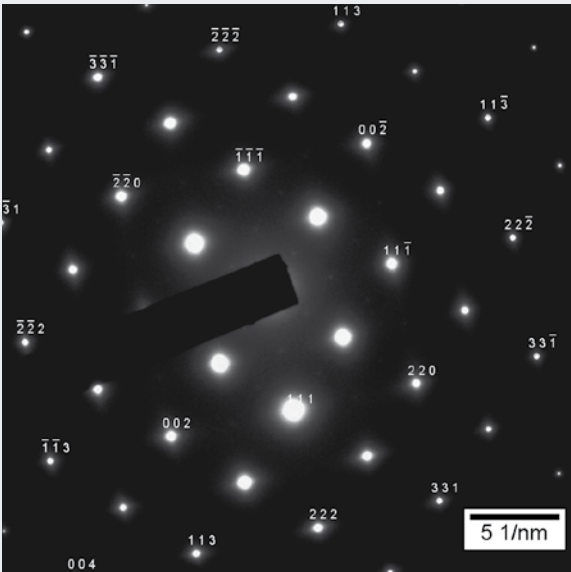
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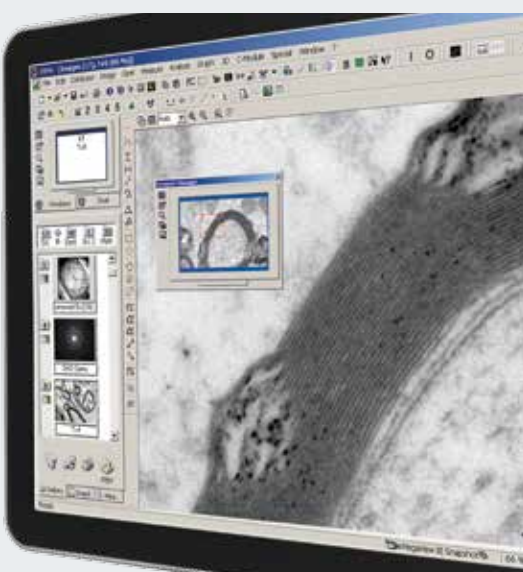
Gold



Field of View



Gold: Diffraction Image



Integration in iTEM and Radius - TEM Imaging Platforms