LVEM5

Low Voltage Electron Microscope

Nanoscale from
your benchtop

delong instruments®

LVEM5
Delong America

COMPACT BUT POWERFUL

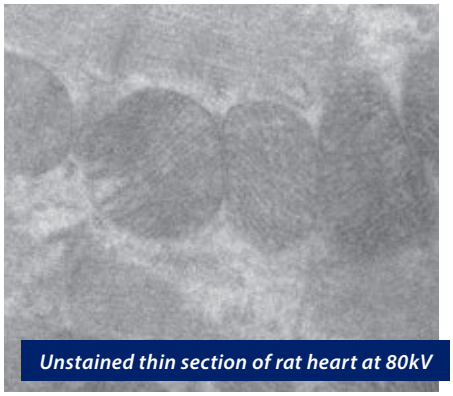
The LVEM5 is designed to excel across a broad range of applications in material sciences, such as nanomaterials, polymers and biomaterials, and in life sciences, such as drug discovery and delivery, pathology and virology. The LVEM5 offers a high throughput benchtop solution with nanometer resolutions.

Benchtop Design: Imaging where you need it most

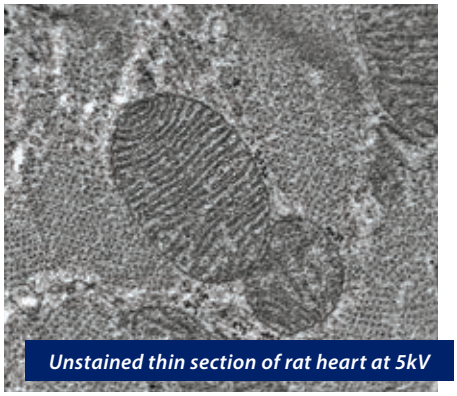
The LVEM5 has an architecture that departs from traditional models. The benchtop design alone is a significant architecture and footprint departure from classical TEM design. The LVEM5 is approximately 90 % smaller than classical electron microscopes. This means that the LVEM5 can be installed in a lab, on a desktop or benchtop; almost anywhere electron imaging is needed. It features a small footprint and is easy to service. There is no need for a dark room or cooling water.

High Contrast

The LVEM5 is a unique investigative tool which combines transmission (TEM, STEM) and surface scanning (SEM) observation modes. High contrast on light elements comes from the 5 kV accelerating voltage, which is substantially lower than in conventional TEM (typically 80–200 kV). This results in increased electron scattering and enhanced contrast on biological, organic and light materials.



Unstained thin section of rat heart at 80kV



Unstained thin section of rat heart at 5kV

COMPONENTS

Field Emission Gun: High brightness and high contrast

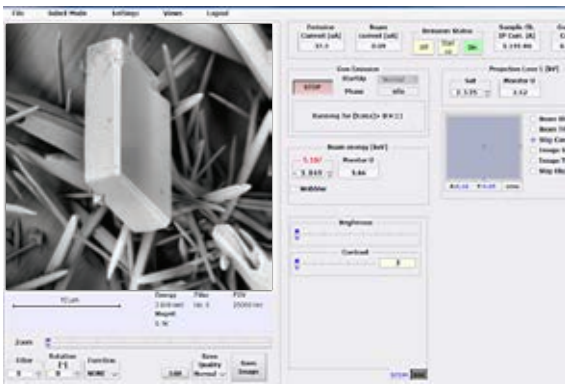
The uniquely-designed Schottky type field emission gun employed by the LVEM5 has very high brightness and spatial coherency with a lifetime of several thousand hours. The high brightness and small virtual source of the electron gun enables high-resolution transmission and scanning modes".

Permanent magnet lenses: Cooling not required

In another industry first, the LVEM5 is designed to operate without any cooling. With conventional electron microscopes active cooling is required to remove considerable heat generated by electric current circulating in the electromagnetic lenses. Uniquely designed permanent magnet lenses used in the LVEM5 remove any need for cooling of its components.

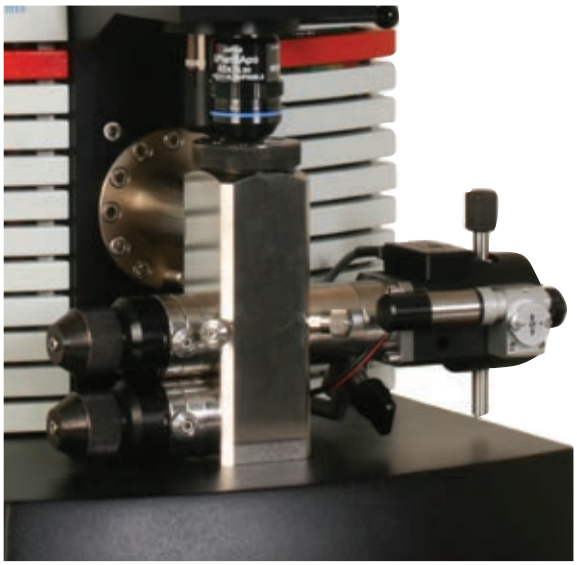
Ion Getter Pumping: Clean vacuum, clean column, clean images

Ion pumps are inherently dry, vibration-free and achieve very high vacuum levels. By making use of specially designed Ion Getter Pumps, the LVEM5 avoids all contamination in the sample space, resulting in stable imaging conditions and absence of artifacts.



Transmission Electron Microscopy: Inline, two stage optics platform

Electron optics provide the initial stages of magnification. Electrons travel upwards through objective and projectors. They continue towards the YAG scintillator screen for formation of the initial image. High spatial resolution on the YAG screen enables using high light-optical magnification in a unique two stage magnification system.



Light optics that are stable and reliable further magnify the initial image on the YAG screen. There is highly efficient light transport from the fluorescent screen into the light optics.

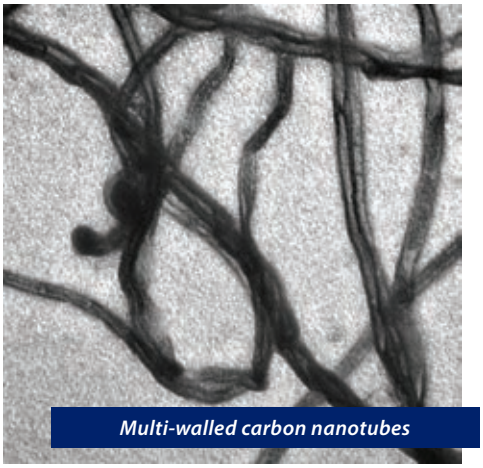
Digital Imaging in TEM mode is by means of a Peltier cooled CCD camera mounted on the top of the LVEM5. Image capture is via QImaging Retiga 4000R, a high sensitivity digital camera with 2048×2048 pixel progressive scan interline CCD. The image capture software is designed for acquisition, documentation, and analysis of high performance image data. Various image processing procedures, such as averaging, live FFT and automatic contrast adjustment are available.

LVEM5
for Material Sciences

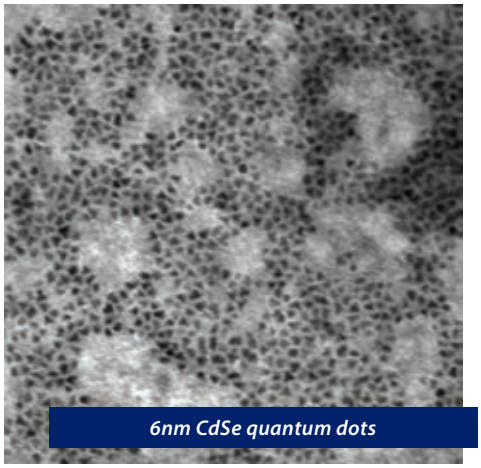
Materials science is a complex field of study applying the different properties of matter to various areas of science and engineering, and has been propelled to the forefront because of its significance in nanotechnology. One of the most important tools available to scientists to investigate the structure of materials at atomic or molecular scales is the electron microscope.

The LVEM5 electron microscope assists researchers in the field of materials science by providing high resolution and rapid imaging of their samples. The LVEM5 shifts the cost-benefit balance by providing nanometer level resolution across 3 imaging modes: TEM (Diffraction included), SEM and STEM. The LVEM5 system combines all these functions in an easy-to-operate tabletop electron microscope, and helps keep time-to-results and efforts-to-results at minimal levels.

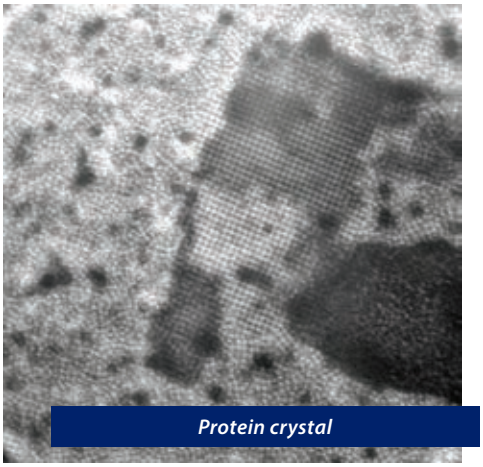
Whether you're studying polymers, nanostructures, composites or blends, the LVEM5 represents a uniquely powerful tool for your research.



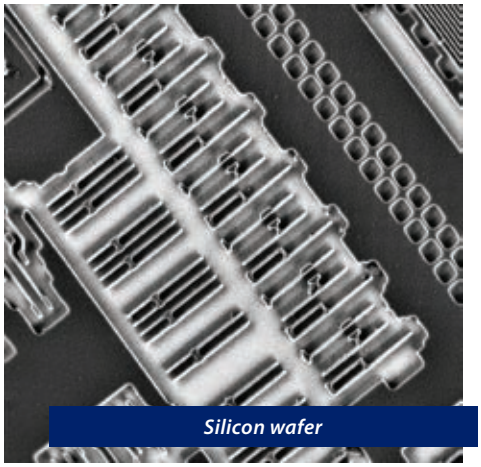
Multi-walled carbon nanotubes



6nm CdSe quantum dots



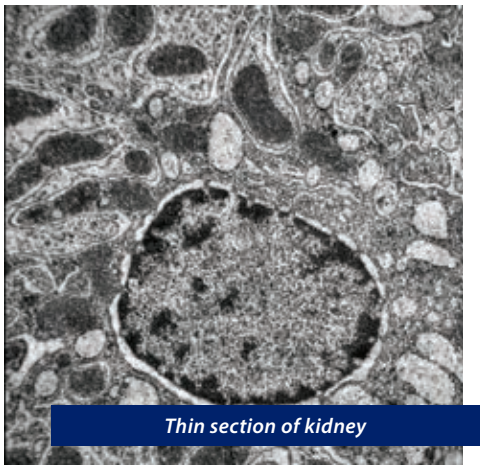
Protein crystal



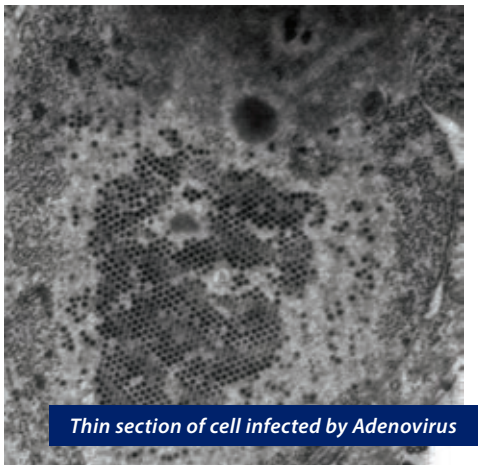
Silicon wafer

LVEM5
for Life Sciences

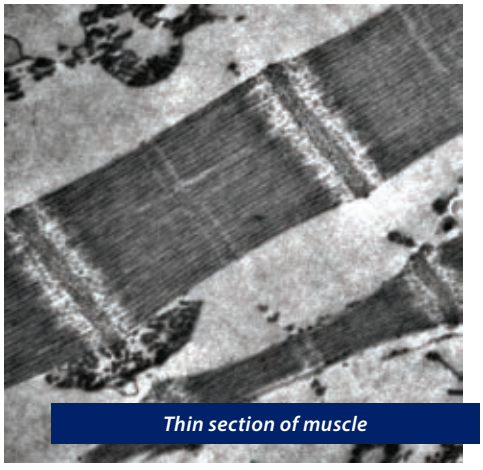
Samples in the life sciences are normally a major challenge to image in an electron microscope due to inherent low contrast provided by their molecular composition. This is not the case when using the LVEM5 in life sciences applications. Issues with sample contrast are eliminated entirely.
Low energy electrons, as found in the LVEM5, interact much more strongly with the sample than high energy electrons of classical TEM. Electrons in the LVEM5 are strongly scattered by organic materials resulting in exceptional differentiation of features.
The low accelerating voltage allows the system to provide high contrast results with no addition of contrast-enhancing staining procedures.
The LVEM5 still allows for staining as an option, yet high contrast results are acquired from samples in their inherent, natural state.
For life scientists, getting high contrast images of unstained samples is something that conventional TEM simply cannot do. The LVEM5 provides high quality results unmatched anywhere else.



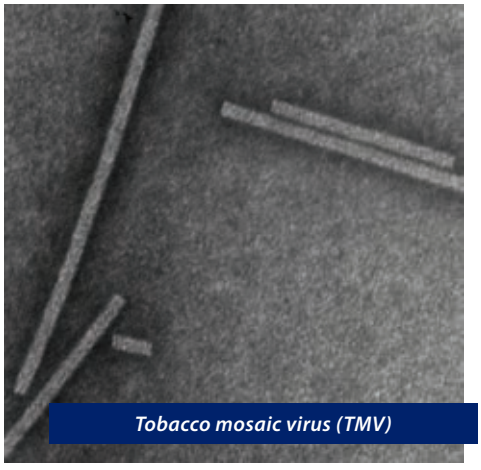
Thin section of kidney



Thin section of cell infected by Adenovirus



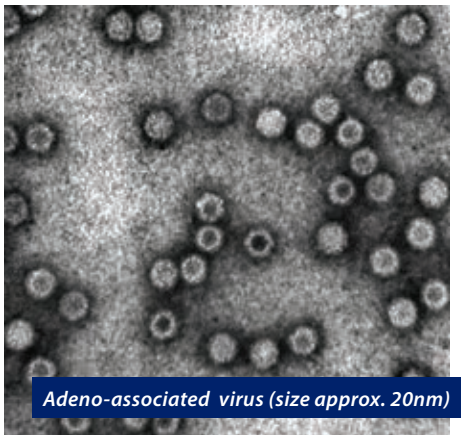
Thin section of muscle



Tobacco mosaic virus (TMV)

TEM BOOST
enhanced imaging module

TEM BOOST is a hardware-based enhancement of TEM imaging mode that provides increased total magnification and higher resolving power in the TEM images. The magnification range is improved to 1,400–700,000×. Combined with an improved resolving power of 1.2 nm, this yields a TEM image resolution of 0.2 nm/pixel at maximum magnification. For nanoparticle analysis this means significantly improved size and shape measurements of objects in the 2–10 nm range. For thin sections this means a larger field of view and enhanced image quality throughout the full range of magnifications.



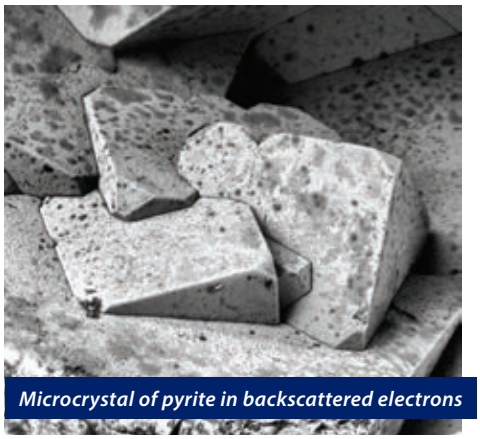
Adeno-associated virus (size approx. 20nm)

SPECIFICATIONS

	LVEM5	LVEM5 with TEM BOOST	Improvement
TEM resolution	2 nm	1.2 nm	40 % more resolving power
Magnification range	2,200–230,000×	1,400–700,000×	200 % more magnifying power

Scanning Electron Microscopy: Integrated detector for multiple modes

In yet another industry first, a backscattered electron detector has been directly incorporated into an electron optics column that was originally designed for transmission electron microscopy alone, enabling scanning electron microscopy to be performed in parallel.
In SEM mode, the electron beam is focused into a narrow spot, and then scanned repeatedly over the sample. The back-scattered electrons are collected by an annular solid-state detector. Images can be saved at resolutions up to 2048×2048 pixels.



Microcrystal of pyrite in backscattered electrons

SPECIFICATIONS

OPERATION	
Nominal accelerating voltage	5 kV
Specimen size	standard ϕ 3.05 mm grids
Time for sample exchange	approx. 3 min.
IMAGING MODES	
BASIC TEM	
Resolving power	2.0 nm
Total magnification	2,200–230,000×
TEM BOOST	
Resolving power	1.2 nm
Total magnification	1,400–700,000×
ELECTRON DIFFRACTION	
Minimum probe size	100 nm
Camera length (binning 1x1)	2,100 pixels
Camera constant (binning 1x1)	36.3 nm pixels
STEM	
Resolving power	2.5 nm
Maximum magnification	250,000×
Maximum field of view	25×25 µm
SEM (BSE DETECTOR)	
Resolving power	3 nm
Maximum magnification	100,000×
Maximum field of view	200×200 µm
ELECTRON OPTICS	
CONDENSER LENS	magnetostatic
The smallest illuminated area	100 nm
Condenser aperture	Φ 50, 30 µm
OBJECTIVE LENS	magnetostatic
Focal length*	1.26 mm
C_s (spherical aberration coefficient)	0.64 mm
C_c (chromatic aberration coefficient)	0.89 mm
α_{theor} (theoretical aperture angle)	10^{-2} rad
Objective aperture	Φ 50, 30 µm
**calculated for 5 kV*	
PROJECTION LENS	electrostatic
BASIC TEM	single lens
TEM BOOST	double lens
ELECTRON GUN	SE Cathode ZrO/W[100]
Current density	0.2 $mAsr^{-1}$
Lifetime	>2,000 hours

TEM IMAGE CAPTURE	
Camera	Retiga 4000R CCD
Sensor size	2048×2048 pixels
Digitalization	12 bits
Pixel size	7.4×7.4 µm
Cooling	Peltier cooling
SCAN IMAGE CAPTURE	
Monitor	512×512 pixels
Saving image	up to 2048×2048
Digitalization	8 bits
LIGHT OPTICS	
Objective Olympus M 40x	NA* 0.95
Objective Olympus M 4x	NA* 0.13
**numerical aperture*	
VACUUM	
AIRLOCK SYSTEM	
Diaphragm and turbomolecular pump	10^{-5} mbar
OBJECT SPACE	
Ion getter pump	10^{-8} mbar
ELECTRON GUN	
Ion getter pump	10^{-9} mbar
CONSUMPTION	
Control electronics in standby	20 VA
Control electronics	160 VA
Including airlock pumping system	300 VA
Camera	24 VA
PC and monitor	450 VA
No cooling water for the microscope is required	
WEIGHTS AND DIMENSIONS	
ELECTRON AND LIGHT OPTICS	
Weight	25 kg
Dimensions (w/o camera)	29×45×43 cm
AIRLOCK PUMPING SYSTEM	
Weight	17 kg
Dimensions	30×30×34 cm
CONTROL ELECTRONICS	
Weight	19 kg
Dimensions	47×27×27 cm

DISTRIBUTION

The LVEM5 is supported globally by sales and service offices in local markets. Please consult our website for the distributor in your country. You can also contact us directly for any questions you may have or to be referred to your distributor.

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