

LVEM 5

Low voltage Transmission Electron Microscope



Compact but powerful

Electron microscopes are indispensable tools for the investigation of objects at the micro and nano scale. The LVEM5 can help you get the information you need.

The LVEM5 is designed to excel across a broad range of applications such as biology, medical diagnosis, and materials science (macromolecular chemistry). Using **unstained samples** you are able to observe the objects close to their native state with ultra high contrast and nanometer resolutions.

Small installation space

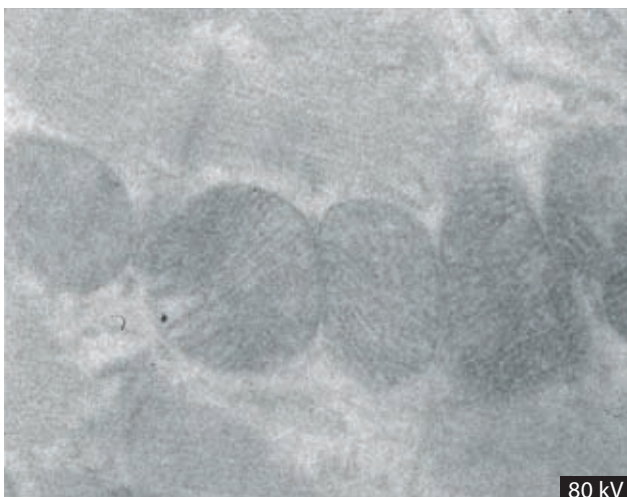
The LVEM5 is a compact benchtop instrument that combines high resolution imaging with the small footprint of an optical microscope. It consists of four separate parts; the microscope, the electronics unit, the vacuum system, and the PC. Small footprint, no need for a dark room, no cooling water, easy service...all this makes the instrument a multi-purpose personal or in-group electron microscope.



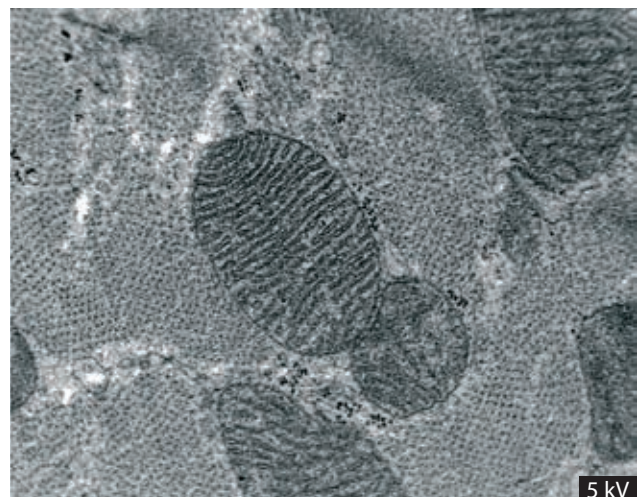
High contrast

The LVEM5 is a unique investigation tool that allows observation of objects composed of light elements (H, C, N, O, S, P) with high contrast **without using heavy metal staining and shadowing**. Samples composed of heavier elements can also be observed either in nanometer scale outline detail or in aggregation (lower magnification) when placed in an appropriate embedding matrix or directly on a carbon coated grid. Thus both stained and unstained samples can be observed.

High contrast of light elements is achieved through a substantial decrease of electron energy (see the comparison images below). An acceleration voltage decrease from 100 kV to 5 kV significantly increases electron scattering and enhances the contrast of standard test samples (20 nm thin carbon film) by more than 10 times. The spatial resolution of the LVEM5 is about 2 nm in all modes.



Unstained thin section of rat heart (80 kV)



Unstained thin section of rat heart (5 kV)

Components

Field emission gun (FEG) and advanced electron optics

The electron gun uses a Schottky field emitter which provides high brightness and coherence with a lifetime of several thousand hours. The high brightness and small virtual source of the electron gun allows transmission and scanning modes. Permanent magnet lenses, an electrostatic lens and electrostatic stigmators and deflectors are used in the electron optics. Permanent magnet lenses are very stable and do not need any cooling.



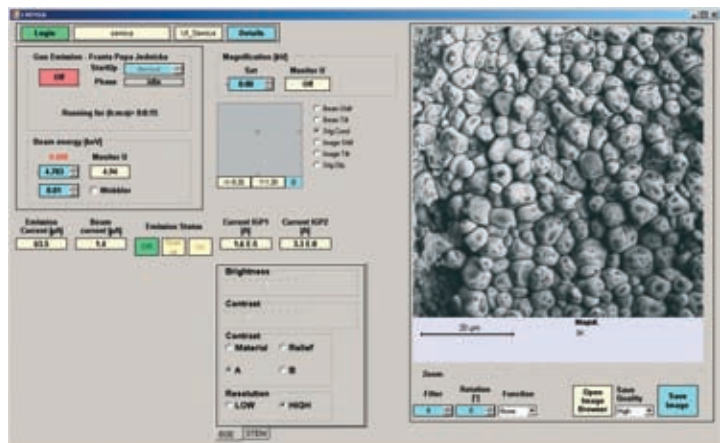
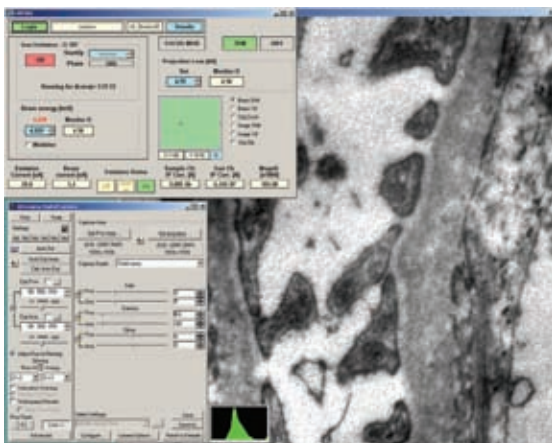
Two-stage magnification

The design of the LVEM5 differs considerably from that of standard TEM. The miniaturized electron optics column is oriented upside down with the electron gun at the bottom side. Low voltage electron optics projects enlarged image on an electron-sensitive YAG screen; this image – which contains details at the nanometer scale – is further magnified by optical objective of a light microscope. The YAG scintillator serves as an image converter between the electron and light optics. The maximum magnification is approx. 200,000 in TEM mode. The overall dimensions of the LVEM5 are comparable with those of conventional light microscopes. Observation of the results is made through binoculars or on a screen via digital camera image capture.

Image capture

A high-sensitivity IEEE 1394 FireWire® QImaging® Retiga-4000R digital camera with 2048 × 2048 pixels progressive-scan interline CCD sensor is attached to the LVEM5. The image capture software is designed for acquisition, documentation, and analysis of high performance image data. Various image processing procedures, such as summing, FFT, histogram, gamma correction, and automatic contrast adjustment are available.

Scanning images can be saved in three resolution levels – 512 × 512, 1024 × 1024, and 2048 × 2048 pixels. Scanning images can be formed by detecting **transmitted** electrons (STEM – scanning transmission electron microscopy), or **backscattered electrons** (BSE). In BSE mode the combination of image signals from two detector segments enables both material and topographic contrast images.



Wide choice of imaging modes

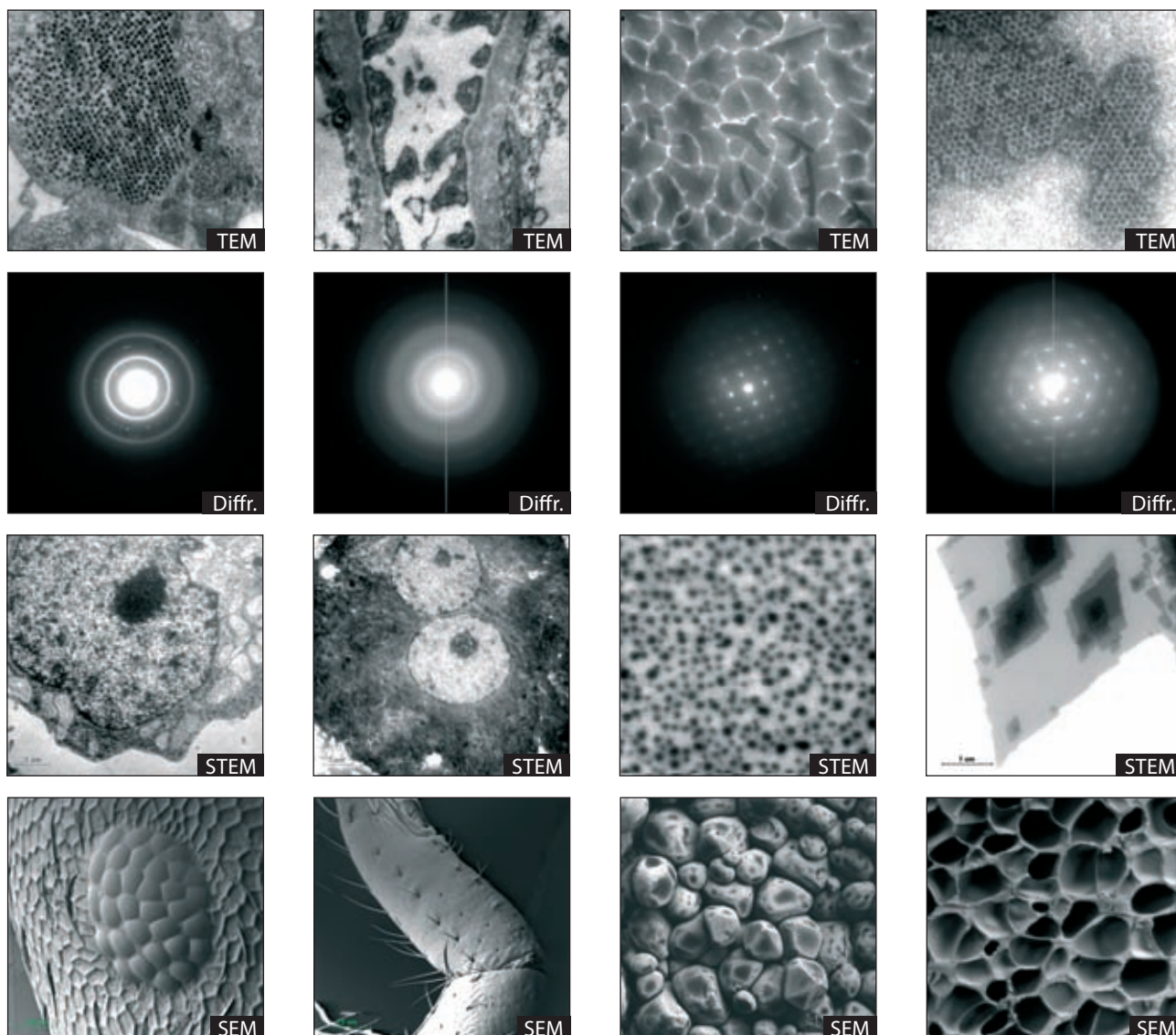
Even though the LVEM5 is the smallest commercial transmission electron microscope in the world, it features all the standard imaging modes that can be found in conventional TEMs and more. The LVEM5 can work in transmission (**TEM** – Transmission Electron Microscope) or diffraction (**SAED** – Selected Area Electron Diffraction) modes as well as in scanning modes (**STEM** – Scanning Transmission Electron Microscope and SEM – Scanning Electron Microscope with **BSE** – Backscattered Electrons) with nanometer spatial resolution.

The following combinations are available:

- ▶ TEM (with SAED)
- ▶ TEM (with SAED) + STEM
- ▶ TEM (with SAED) + SEM
- ▶ TEM (with SAED) + STEM + SEM

Applications

LVEM 5 is a novel solution for imaging in life sciences and materials science (macromolecular chemistry).



Easier sample preparation techniques

Conventional preparation techniques are simplified because staining and shadowing may be avoided. The observed image is the real structure without any artifacts stemming from staining or shadowing, closer to the native state of your samples. The sample thickness should be up to 50 nm in TEM mode, up to 70 nm in STEM mode, depending on the sample material. The samples are placed on standard 3 mm discs or grids.

Accelerating voltage (nominal)	5 kV	Imaging modes	
Specimen	standard Φ 3.05 mm grids	TEM	
time for sample exchange	approx. 3 min	resolving power	2.5 nm
		total magnification ^{*)}	1,500–150,000
Electron optics		*) depending on the size of the camera chip	
		ED (electron diffraction)	
Condenser lens	permanent magnet	minimum probe size	100 nm
focal length*	4.30 mm	diffraction lens	magnification 3.5
the smallest illuminated area	100 nm		
condenser apertures	Φ 50, 30 μ m	STEM	
* calculated for 5 kV		resolving power	2.0 nm
		minimum magnification	(25 \times 25 μ m) 6,000
Objective lens	permanent magnet		
focal length*	1.26 mm	SEM (BSE detector)	
C _s (spherical aberration coefficient)	0.64 mm	resolving power	4 nm
C _c (chromatic aberration coefficient)	0.89 mm	minimum magnification	(200 \times 200 μ m) 800
δ_{teor} (theoretical resolution)	1.1 nm		
α_{teor} (theoretical aperture angle)	10 ⁻² rad	Vacuum	
objective aperture	Φ 50, 30 μ m		
* calculated for 5 kV		Airlock system	
		diaphragmal pump	10 ⁻⁵ mbar
Projection lens	electrostatic	and turbomolecular pump	
magnification on the YAG screen	36–470		
		Object space	
Electron gun		ion getter pump (10 l sec ⁻¹)	10 ⁻⁸ mbar
SE cathode ZrO/W[100]			
current density	0.2 mA sr ⁻¹	Electron gun	
lifetime	> 2,000 hours	ion getter pump (7 l sec ⁻¹)	10 ⁻⁹ mbar
Light optics		Weights and dimensions	
objective Olympus M 40x	NA 0.90		
objective Olympus M 4x	NA 0.13	Electron and light optic system	
binocular M 10x		weight	25 kg
Olympus U-TR30-2 widefield trinocular observation tube		dimensions (w \times d \times h) without camera	290 \times 450 \times 430/480 mm
TEM image capture		Airlock pumping system Pfeiffer Vacuum TSH 071E	
camera	Retiga 4000R CCD	weight	15 kg
pixel size	2048 \times 2048 pxls	dimensions (w \times d \times h)	300 \times 300 \times 340 mm
digitalization	12 bits		
pixel size	7.4 \times 7.4 μ m	Control electronics	
cooling	optional Peltier cooling available	weight	19 kg
		dimensions (w \times d \times h)	470 \times 270 \times 290 mm
SCAN modes image capture		Consumption	
monitor	512 \times 512 pxls	Control electronics in stand by (ion getter pumps only)	20 VA
saving image	up to 2048 \times 2048 pxls	Control electronics	160 VA
digitalization	8 bits	Including airlock pumping system	300 VA
		Camera	24 VA
		PC and monitors	approx. 450 VA
		No cooling water for the microscope operation is required.	

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.

The LVEM5 Sales and Marketing group can be reached at:**EUROPE:**

DELONG INSTRUMENTS a. s.
Palackého tř. 153b
CZ-612 00 Brno
Czech Republic
Tel.: +420 549 123 509
+420 549 123 511
Fax: +420 541 217 976
email: sale@dicomps.com
website: dicomps.com

U. S. A.:

Delong America Inc.
4020 Rue S. Ambroise
Montreal, Quebec, Canada
H4C 2C7
USA:
1-866-DELONGUSA (1-866-335-6648)
International: 1-514-904-1202
info@lv-em.com
www.lv-em.com

Your local distributor:

