LVEM 5

Low Voltage Transmission Electron Microscope

All-in-one,
all-for-you...

New

TEM, STEM, SEM

the compact 3-in-1

CORDOUAN Technologies

CORDOUAN Technologies, specialized in nanomaterials caracterisation by dynamic light scaterring (DLS) technology joins the Delong Group to introduce in France **the first benchtop transmission electron microscope that combines TEM, SEM and STEM imaging.**
CORDOUAN Technologies initiates an exclusive partnership with the Delong Group to promote a unique imaging tool : the benchtop transmission electron microscope LVEM 5.

Compact & powerful

Electron microscopes are indispensable tools for the investigation of objects at the micro and nano scale. The LVEM 5 can help you get the information you need.
The LVEM 5 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

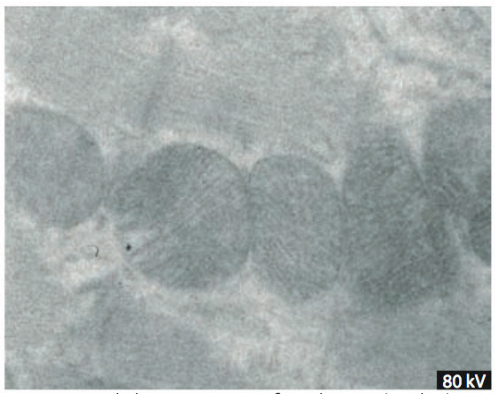
The LVEM 5 is a compact benchtop instrument that combines high resolution imaging with the small footprint of an optical microscope. It consists of four separate parts; the microscope, the electronics unit, the vacuum system, and the PC. **Small footprint, no need for a dark room, no cooling water, easy service…**all this makes the instrument a multi-purpose personal or in-group electron microscope.

Compare classical TEM imaging vs. LVEM 5 at www.cordouan-tech.com

High contrast

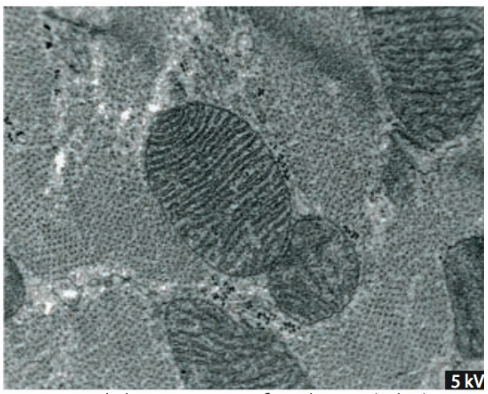
The LVEM 5 is a unique investigation tool that allows observation of objects composed of light elements (H, C, N, O, S, P) with **high contrast without using heavy metal staining and shadowing.** Samples composed of heavier elements can also be observed either in nanometer scale outline detail or in aggregation (lower magnifi cation) 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 fi lm) by more than 10 times. **The spatial resolution of the LVEM 5 is about 2 nm in all modes.**

Classical TEM



Unstained thin section of rat heart (80 kV)

LVEM 5



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.

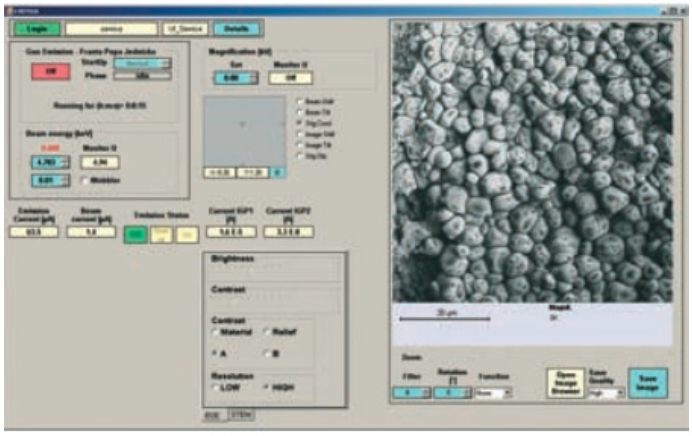
Two-stage magnification

The design of the LVEM 5 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 LVEM 5 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 LVEM 5. 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.



LVEM 5 user interface with image acquisition software.

Wide choice of imaging modes

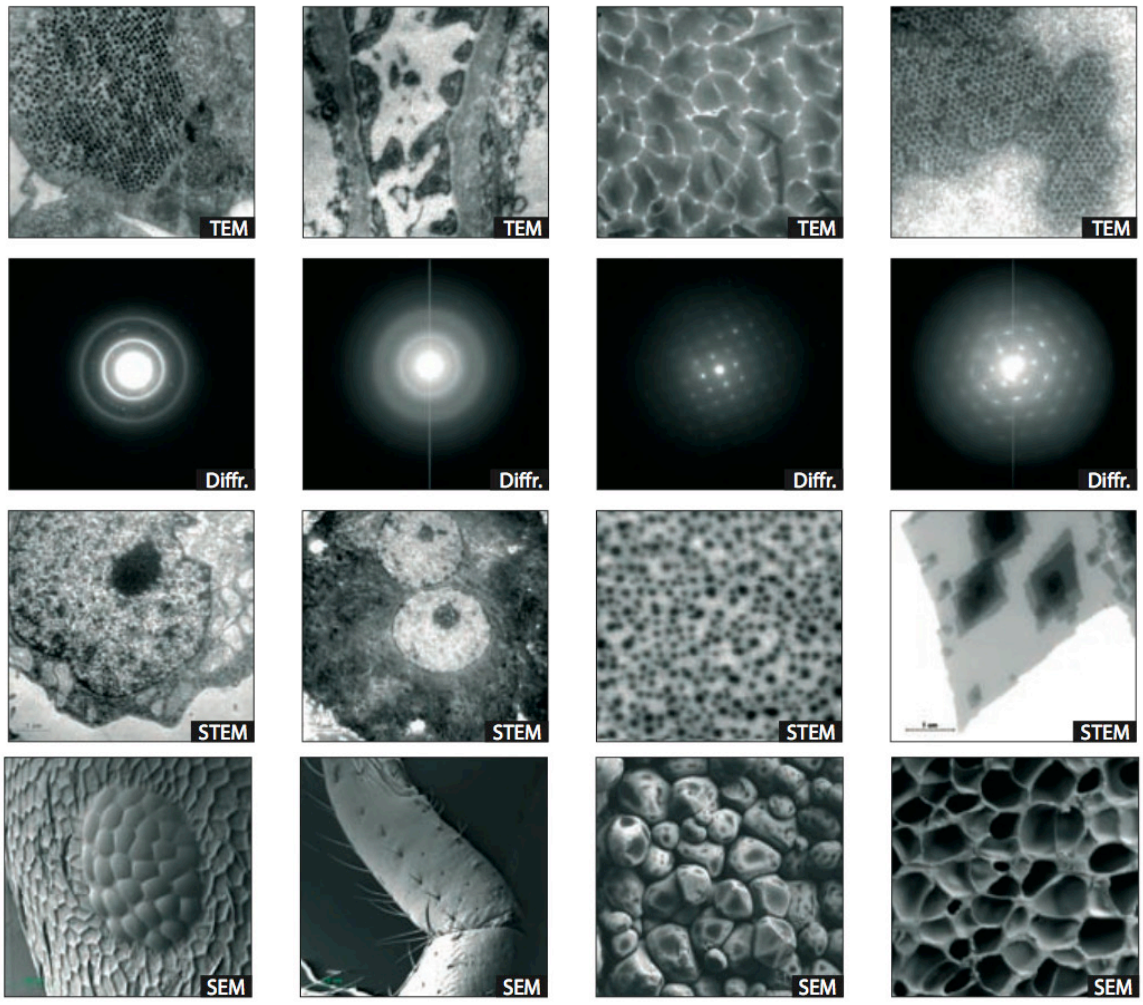
The LVEM 5 is the smallest commercial transmission electron microscope in the world. It features all the standard imaging modes that can be found in conventional TEMs and more. The LVEM 5 can work in transmission (TEM – Transmission Electron Microscope) or diffraction (SAED – Selected Area Electron Diffraction) 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.

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

All-in-one, all-for-you...

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.

Technical specifications

Imaging modes

TEM

resolving power	2.5 nm
total magnification*	1,500-202,000

*depending on the camera ship

STEM

resolving power	2.0 nm
minimum magnification	6,000 (25 x 25 µm)

SEM (BSE detector)

resolving power	4 nm
minimum magnification	800 (200 x 200 µm)

ED (electron diffraction)

minimum probe size	100 nm
diffraction lens	magnification 3.5

Accelerating voltage (nominal)	5 kV
Specimen	standard ϕ 3.05 mm grids
time for sample exchange	approx. 3 min

Weight and dimensions

Electron and light optic system

weight	25 kg
dimensions (WxDxH) without camera	290x450x430/480 mm

Airlock pumping system Pfeiffer Vacuum TSH 071E

weight	15 kg
dimensions (WxDxH)	300 x 300 x 340 mm

Control electronics

weight	19 kg
dimensions (WxDxH)	470 x 270 x 290 mm

Vacuum

Airlock system

diaphragmal pump	10^{-5} mbar

Object space

ion getter pump (10 L.sec^{-1})	10^{-8} mbar

Electron gun

ion getter pump (7 L.sec^{-1})	10^{-9} mbar

Electron optics

Condenser lens (permanent magnet)

focal length*	4.30 mm
the smallest illumination area	100 nm
condensor apertures	ϕ 50, 30 µm

*calculated for 5 kV

Objective lens (permanent magnet)

focal length*	1.26 mm
C_s (spherical aberration coefficient)	0.64 mm
C_c (chromatic aberration coefficient)	0.89 mm
δ_{teor} (theoretical resolution)	1.1 nm
α_{max} (theoretical aperture angle)	10^{-2} rad
objective aperture	ϕ 50, 30 µm

*calculated for 5 kV

Projection lens (electrostatic)

magnification on the YAG screen	36-470

Electron Gun

SE cathode ZrO/W[100]	
current density	0.2 mA.sr^{-1}
lifetime	>2,000 hours

Light optics

objective Olympus M 40x	NA 0.90
objective Olympus M 4x	NA 0.13
binocular M 10x	
Olympus U-TR30-2 wide field trinocular observation tube	

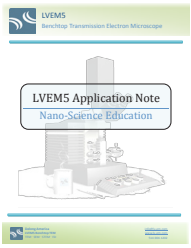
TEM image capture

camera	Retiga 4000R CCD
resolution	2048 x 2048 pixels
digitalization	12 bits
pixel size	7.4 µm x 7.4 µm
cooling	optional Peltier cooling available

Scan modes image capture

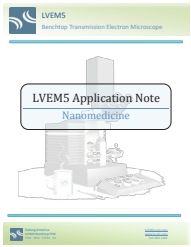
monitor	512 x 512 pixels
saving image	up to 2048 x 2048 pixels
digitalization	8 bits

Download our application notes at www.cordouan-tech.com



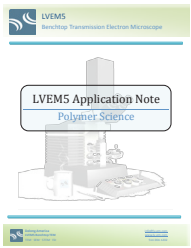
LVEM5 in Nano-Science Education

The LVEM5 tool will allow you to introduce students to all areas of nanoscale. Real hands-on experience with three different types of Nano-imaging techniques commonly used in industry will certainly give your students a competitive edge upon entry into the workforce. *Read more...*



Nanomedicine, how the LVEM5 helps ?

With the LVEM5 you will be able to resolve the sizes of your nanoparticles with improved contrast to understand the quality of your synthesis on a number of levels. You will be able to discern particle size, quantity and distribution. This can all be easily accomplished in minutes on the LVEM5, right in your own lab. You get all this for a fraction of the price of a conventional electron microscope. *Read more...*



Polymer Science

The LVEM has proven to be particularly useful for the high contrast imaging of a wide variety of polymers, organic molecular thin films, and biological materials. We have obtained images on a variety of systems including polyethylene single crystals, pentacene and TIPS-pentacene thin films, block copolymers, and poly(3,4-ethylene dioxythiophene). *Read more...*

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