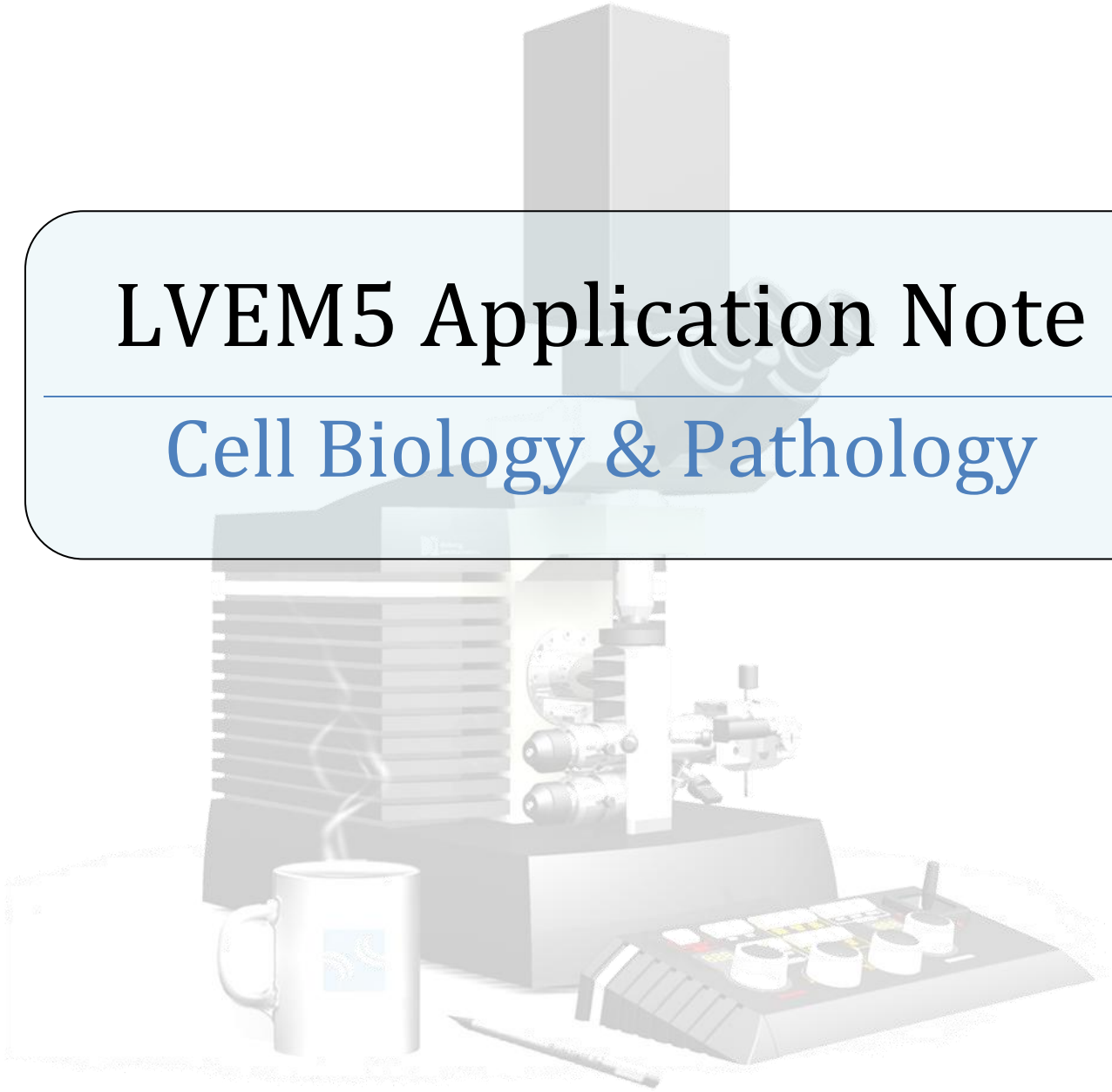
LVEM5

Benchtop Transmission Electron Microscope

LVEM5 Application Note

Cell Biology & Pathology



Delong America
LVEM5 Benchtop TEM
TEM · SEM · STEM · ED

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Cell Biology & Pathology

Introduction

"The LVEM5 in cell biology and pathology can be particularly useful both in routine microscopy and in research.

For routine examination of pathological specimens, the instrument generates images that are identical to those generated by a conventional 80KV transmission electron microscope. The LVEM has the advantage of avoiding post-sectioning staining with heavy metals such as uranyl acetate and lead citrate. Even without counterstaining, the tissue reveals the usual cellular structures as a standard 80KV transmission microscope due to the high contrast generated by the low voltage. Compared to standard electron microscopes, the LVEM5 has the advantage of being of very small size and the time for the examination of a sample is reduced to a minimum.

In cell biology and active morphological research of cellular and subcellular structures, this instrument opens an entirely new field. The low voltage and the high contrast that it generates allow for simplified fixation protocols. Fixation with osmium tetroxide is not required anymore to generate nice contrasted images of cell membranes and cell components. Furthermore, due to the fact that the electrons are not highly accelerated, penetration, scattering and transmission of electrons through the section are much more efficient and generate differences in contrasts within cell structures that, up to now, were considered quite homogeneous. Hence, substructures and heterogeneities unknown up to now can be revealed within cellular compartment that were considered homogeneous.

The LVEM5 carries a great potential for advancing our comprehension of cellular structures and of their composition and organization."

- Dr. Moïse Bendayan

Professor of Pathology & Cell Biology

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Moïse Bendayan, PhD

Dr. Bendayan's research activities are focused on the cell biology of protein secretion, blood capillary permeability and transendothelial transport of plasma proteins, development of diabetic microangiopathy and glomerulosclerosis, islet-duct-acinar pancreatic axis, entero-pancreatic axis and gastro-enteric axis in normal and diabetic conditions.

Molecular morphology is the main approach used in these research activities, as he developed established and improved innovative techniques in high resolution electron microscopy. He has published over 260 scientific original peer-reviewed articles, as senior author of publications in outstanding journals such as Science, J. Cell Biol., J. Biol. Chem., J. Cell Science, Am. J. Physiol and J. Histochem Cytochem.

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How the LVEM5 helps

Versatile

The LVEM5 is the ideal addition to any Cell Biology or Pathology laboratory. Its multimodal imaging capabilities makes it a comprehensive imaging tool. The LVEM5 is truly a 3-in-1 electron microscope. Not only is it a Transmission Electron Microscope (TEM), but it can be configured with up to two different scanning modes for use as a Scanning Election Microscope (SEM) and a Scanning Transmission Electron Microscope (STEM). With the LVEM5 you can switch between imaging modes without moving your sample. This way you can capture both surface and transmission images from the same area of interest. With only one tool you can significantly improve the understanding of your nanoparticles.

Miniature Form Factor

The LVEM5 is the only multi-modal electron microscope available in a benchtop configuration. No longer will you need to send batches of samples to a core-imaging facility, wasting time and resources. The LVEM5's miniature size means that it can be installed in your workspace, right where you need it. The LVEM5 does not require a dedicated facility for installation. No special power or cooling requirements are needed and vibration isolation is generally not a concern.

Resolution & Contrast

Don't let the small size of the LVEM5 mislead you. It may be miniature in size but it's a giant advantage in the lab. The LVEM5 is capable of resolving objects as small as 2 nanometers in transmission and scanning modes. Additionally, the LVEM5 is capable of producing higher contrast images than a conventional transmission electron microscope without the need for stain. In no way are you sacrificing imaging quality or obtainable resolution with a benchtop configuration. The LVEM5 easily produces high quality images suitable for presentations or publications.

Accessible

The LVEM5 is so remarkably simple that anyone can use it. No longer will you need highly trained technicians to take electron micrographs. The controls are intuitively configured on an ergonomically designed remote control panel that can be positioned as required. Feedback is provided directly on the control panel as well as through the LVME5's comprehensive software. Every installation of a LVEM5 includes personalized on-site training. By the end of training, users are capturing meaningful images. If support or assistance is ever needed, the LVEM5 technical staff is readily available by phone or email.

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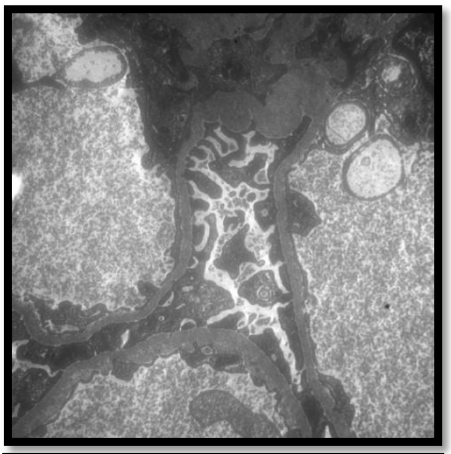
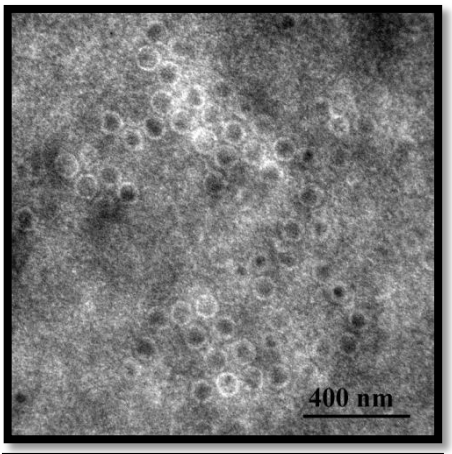
What this all means for you

The LVEM5 can be used both conventionally, employing standard TEM protocols and also "non-conventionally", modifying sample prep routines to exclude staining (either on the pre-embedding or post-embedding stages, or completely). Adequate contrast on features of interest is achieved on unstained sections which makes it a unique tool for a number of special purpose investigations, where staining is prohibitive.

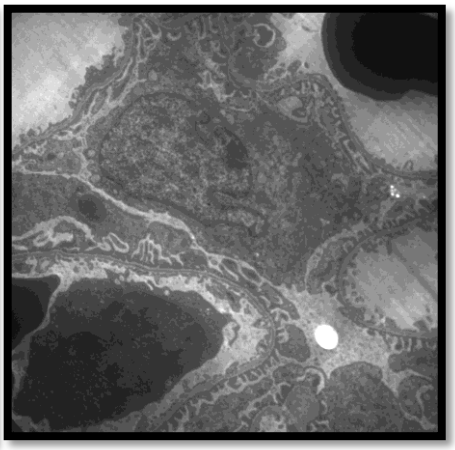
Selected Images



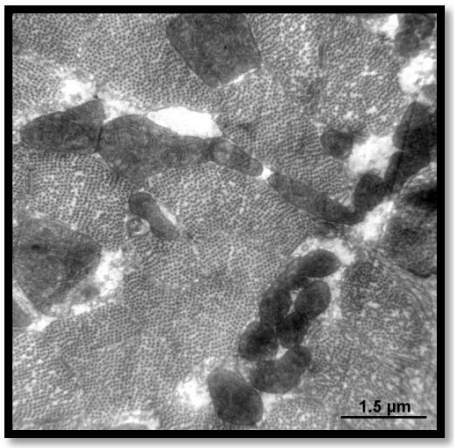
Unstained Kidney Section
TEM



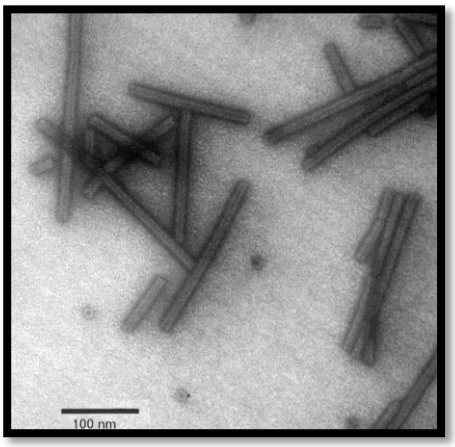
Unstained Adenovirus in Tissue
TEM



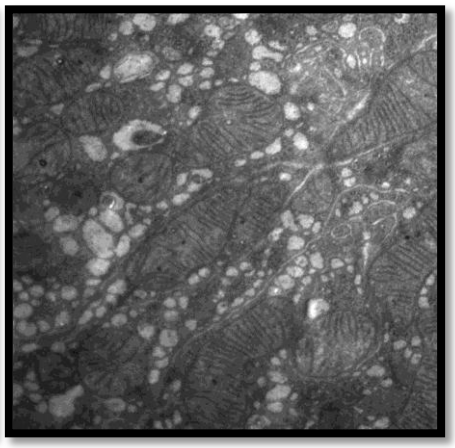
Unstained Kidney Section
TEM



Grasshopper Muscle
TEM



Negatively Stained TMV
TEM



Unstained Mitochondria
TEM

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Specifications

Operation	
Nominal accelerating voltage	5 Kv
Specimen Size	Standard ϕ 3.05 mm grids
Time for sample exchange	Approx 3 min.

Electron Optics	
Condenser lens	**Permanent magnet**
Focal length*	4.30 nm
The smallest illuminated area	100 nm
Condenser aperture	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_{theor} (theoretical resolution)	1.12 nm
α_{theor} (theoretical aperture angle)	10^{-2} rad
Objective aperture	Φ 50, 30 µm
**calculated for 5 Kv*	
Projection Lens	**electrostatic**
Electron Gun	**SE Cathode ZrO/W[100]**
Current density	0.2mA sr^{-1}
Lifetime	> 2,000 hours

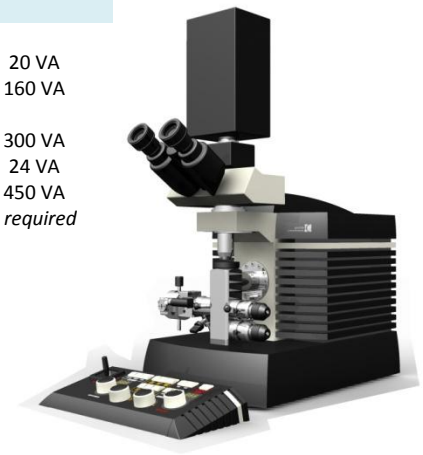
Light Optics	
Objective Olympus M 40x	NA 0.90
Objective Olympus M 4x	NA 0.13
Binocular M 10x	
Olympus U-TR30-2 widefield trinocular observation tube	
TEM image capture	
Camera	Retiga 400R CCD
Pixel size	2048 x 2048 pixels
Digitalization	12 bits
Pixel size	7.4 x 7.4 µm
Cooling	Peltier cooling
Scan image capture	
monitor	512 x 512 pixels
Saving image	Up to 2048 x 2048 pixels
digitalization	8 bits

Imaging Modes	
TEM	
Resolving power	
TEM BOOST	1.2 nm
Basic System	2.0 nm
Total magnification	
TEM BOOST	1,400 – 700,0000x
Basic System	5,000 – 202,0000x
ED	
Minimum probe size	100 nm
Diffraction lens	Magnification 3.5
STEM	
Resolving power	2.0 nm
Minimum magnification	(25 x 25 µm) 6,000x
SEM (BSE detector)	
Resolving power	3 nm
Minimum magnification	(200 x 200 µm) 640x

Vacuum	
Airlock System	
Diaphragm and turbomolecular 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

Consumption	
Control electronics in standby (ion getter pumps only)	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 x 45 x 43 cm
Airlock pumping system	
Weight	15 kg
Dimensions	30 x 30 x 34 cm
Control Electronics	
Weight	19 kg
Dimensions	47 x 27 x 27 cm



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