

Useful resources for diagnostic electron microscopy of infectious diseases

Author: Dr. Michael Laue, Robert Koch Institute, Berlin, Germany (lauem@rki.de)

This document provides links to some of our published standard protocols, to reference materials and to subjectively selected papers from others.

Methods

Overview

Biel & Gelderblom (1999) In: *Virus Cell Culture* p.111-147.

Laue (2010) *Meth. Cell Biol.* [https://doi.org/10.1016/S0091-679X\(10\)96001-9](https://doi.org/10.1016/S0091-679X(10)96001-9)

Miller (1986) *J. Elect. Microsc.* <https://doi.org/10.1002/jemt.1060040305>

Negative staining protocol

<https://zenodo.org/record/1468676>

Negative staining video

<https://zenodo.org/record/1468500>

Negative staining (including airfuge enrichment) detection limit

Laue & Bannert (2010) *J. Appl. Microbiol.* <https://doi.org/10.1111/j.1365-2672.2010.04737.x>

Negative staining, enrichment by filtration

Beniac et al. (2014) *Viruses* <https://doi.org/10.3390/v6093458>

Negative staining, inactivation of virus suspensions

Möller et al. (2015) *Viruses* <https://doi.org/10.3390/v7020666>

Immuno-negative staining – detection of molecules

Laue (2010) *Meth. Cell Biol.* [https://doi.org/10.1016/S0091-679X\(10\)96001-9](https://doi.org/10.1016/S0091-679X(10)96001-9)

Immuno-negative staining – aggregation by cross-linking

Lavazza et al. (2015) *Viruses* <https://doi.org/10.3390/v7052683>

Negative staining & tomography

Mast & Demeestre (2009) *Diagnostic Pathol.* <https://doi.org/10.1186/1746-1596-4-5>

Thin section EM, including rapid protocol

Laue (2010) *Meth. Cell Biol.* [https://doi.org/10.1016/S0091-679X\(10\)96001-9](https://doi.org/10.1016/S0091-679X(10)96001-9)

Thin section EM of (patient) virus suspensions

Laue et al. (2023) *Virolog. J.* <https://doi.org/10.1186/s12985-023-01981-9>

Diagnostic EM with Low-voltage (S)EM

Möller et al. (2020) *J. Histochem. Cytochem.* <https://doi.org/10.1369/0022155420929438>

Diagnostic EM & machine learning

Matuszewski & Sintorn (2021) *Comp. Meth. Progr. Biomed.*
<https://doi.org/10.1016/j.cmpb.2021.106318>

Xiaoa et al. (2021) *Comp. Meth. Progr. Biomed.* <https://doi.org/10.1016/j.cmpb.2020.105766>

VirusExplorer DEM - A reference database for diagnostic EM of viruses

VirusExplorer DEM

<https://zenodo.org/record/4897236>

VirusExplorer DEM Image catalogue (PDF version of the images included in the database)

<https://zenodo.org/record/4900042>

SARS-CoV-2 / COVID-19

Morphology of SARS-CoV-2 in cell culture

Eymieux et al. (2021) *Cell. Mol. Life Sci.* <https://doi.org/10.1007/s00018-020-03745-y>

Laue et al. (2021) *Sci. Rep.* <https://doi.org/10.1038/s41598-021-82852-7>

Morphology of SARS-CoV-2 in patient samples

Bullock et al. (2021) *Micr. Res. Techn.* <https://doi.org/10.1002/jemt.24115>

Dittmayer et al. (2020) *Lancet* [https://doi.org/10.1016/S0140-6736\(20\)32079-1](https://doi.org/10.1016/S0140-6736(20)32079-1)

Cortese et al. (2022) *Virch. Arch.* <https://doi.org/10.1007/s00428-022-03308-5>

Kataoka et al. (2022) *Histopath.* <https://doi.org/10.1111/his.14637>

Krasemann et al. (2022) *eBioMed.* <https://doi.org/10.1016/j.ebiom.2022.104193>

Laue et al. (2023) *Virolog. J.* <https://doi.org/10.1186/s12985-023-01981-9>

Meinhard et al. (2021) *Nat. Neurosc.* <https://doi.org/10.1038/s41593-020-00758-5>

Ultrastructural pathology of the lung in fatal COVID-19 cases

Cortese et al. (2022) *Virch. Arch.* <https://doi.org/10.1007/s00428-022-03308-5>

Ochs et al. (2021) *Europ. Resp. J.* <https://doi.org/10.1183/13993003.04165-2020>

Clinical cases

Mpox

Müller et al. (2022) *Lancet* [https://doi.org/10.1016/S0140-6736\(22\)01969-9](https://doi.org/10.1016/S0140-6736(22)01969-9)

Molluscipox

Müller et al. (2018) *JDDG* <https://doi.org/10.1111/ddg.13633>

Cowpox

Grönemeyer et al. (2017) *Lancet* [https://doi.org/10.1016/S0140-6736\(17\)31428-9](https://doi.org/10.1016/S0140-6736(17)31428-9)