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Cryo Imaging of Life Science and Soft matter Samples by a State of the Art 120kV EFTEM

M. Thaler*, S. A. Hiller*, C. Dietl*, V. Seybold* and G. Benner*

* Carl Zeiss NTS GmbH, D-73447 Oberkochen, Germany

Cryo Transmission Electron Microscopy (cryoTEM) of frozen hydrated samples is a modern approach which has been established to go far beyond the static ultrastructural imaging of tissue to reveal structural and functional information of native structures in biological and soft-matter systems (Fig 1). Cryo TEM is a powerful technique for the visualisation of delicate and dynamic structures without the introduction of artefacts due to conventional staining or drying procedures.

During the last years the method has significantly contributed to the understanding of divers and complex substances in aqueous solutions. In particular, many studies using CryoTEM on liposomes (Fig. 2) used as carrier for drugs have been presented ([1], [2], [3], [4]). CryoTEM supports studies of structural and functional properties of bio-inspired surfactants for controlled fabrication of sophisticated nano-carriers and gets growing importance in pharmaceutical applications to exploit lipids as models in nanotechnology. It allows investigations on structural transitions of aggregates and substances e.g. DLPA micellar solutions upon thermal treatment ([5], [6]) which can help molecular design of functional surfactants and increase knowledge about disease-related peptides [7].

In-column energy filter transmission electron microscopes (EFTEM`s) feature fundamentally advantages for cryo investigations which greatly surpass the performance of modern conventional TEM`s and clearly extend their limits [8], [9]. This presentation will cover the benefits of EFTEM`s for cryo imaging. The newly introduced EFTEM Libra 120® PLUS of Carl Zeiss is available in a dedicated cryo configuration. Dedicated Low Dose Plug-ins for image processing systems are available which allow a complete and easy to use automation of low dose experiments taking full advantage of the flexibility of the Köhler illumination system [10] to reduce beam damage of a frozen sample to the absolute minimum. All the basic advantages of the Libra 120® EFTEM series become even more effective due to a new vacuum system. A constitutional redesign of the column hardware now offers significantly improved partial pressure rates around the specimen area which allow prolonged cryo work with negligible ice grow rate < 1nm/h. The new Libra 120® PLUS vacuum systems are field-upgradeable, permitting to start with the basic version minimizing ownership costs but safeguarding future applications that can not be seen yet.

The redesigned electron optical column, completely dry vacuum system and the integrated OMEGA energy filter as an imaging element combined with most flexible illumination concept (Köhler) available for TEM`s outlines this instrument to an easy workhouse for everyday's cryo applications in a wide application range.
The benefits of EFTEM using the L120® PLUS for cryo applications will be explained and some highlights of results will be presented.

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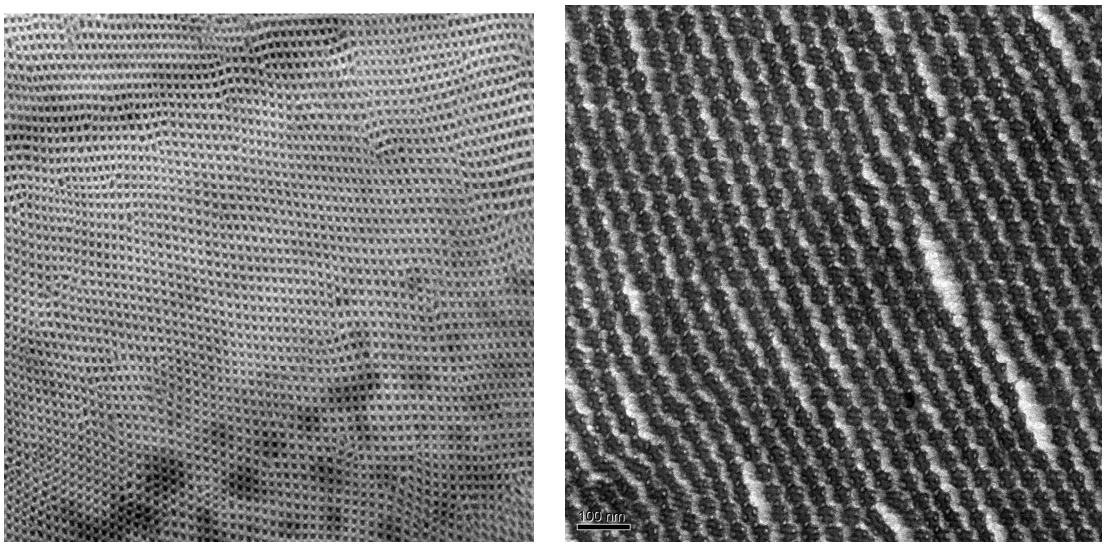
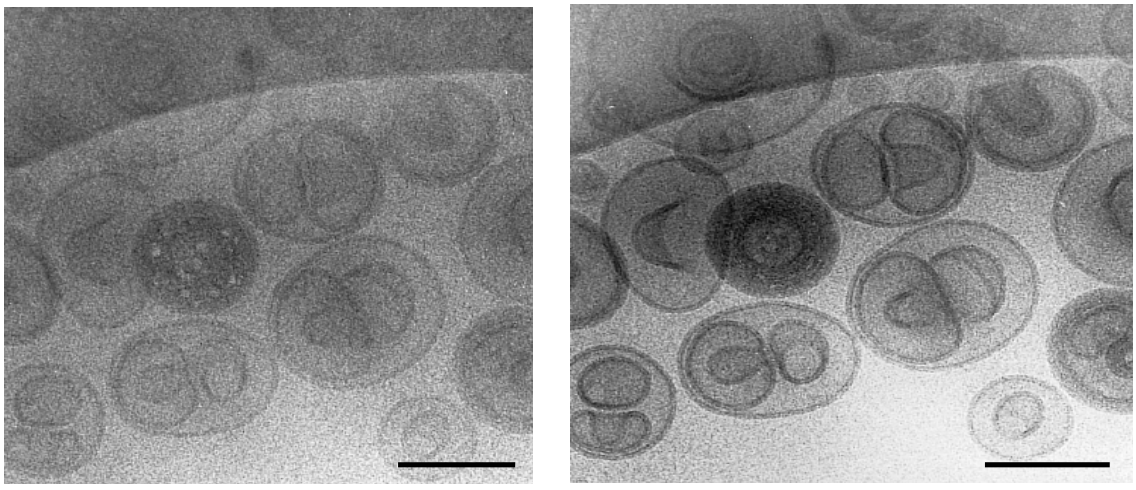


Fig 1
Cryo-TEM micrographs of block-copolymers, images are zero-loss filtered. Images courtesy of M. Drechsler, E. Egbali & H. Hofmann, Univ. Bayreuth, Germany



Unfiltered image **Filtered image**

Fig. 2
Frozen hydrated liposomes: Comparison between Conventional and Energy filtered TEM imaging. Scale bar = 100nm. Comparison between unfiltered (left) and Zero loss filtered image (right) shows higher contrast, less noise and better resolution for the filtered low dose image

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