State of the art 120 kV Cryo EFTEM applications in life science and soft matter

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Cryo Transmission Electron Microscopy (cryo TEM) of frozen hydrated samples is a powerful technique for the visualisation of beam sensitive 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 structural and functional properties of complex biological and soft-matter systems (Figure 1) (in aqueous solutions). Cryo TEM supports studies 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. In particular, many studies using Cryo TEM on liposomes (Figure 2) used as carrier for drugs have been presented ([1], [2], [3], [4]). This modern approach of TEM investigations increases knowledge for molecular design of functional surfactants and about disease-related peptides ([5], [6]) [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 comprehensive modification 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 now completely dry vacuum system is field-upgradeable; permitting to start with the basic version but keeping all options open for future applications that are not in focus yet. The benefits of EFTEM using the L120® PLUS for everyday's cryo applications will be explained and some highlights of results will be presented.

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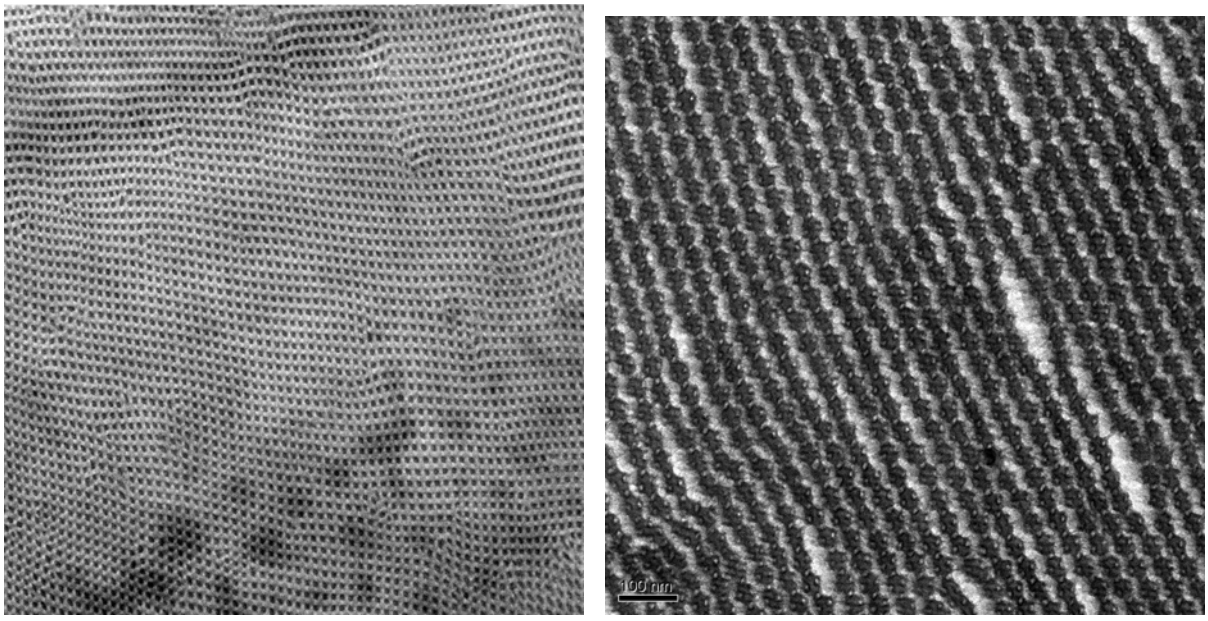
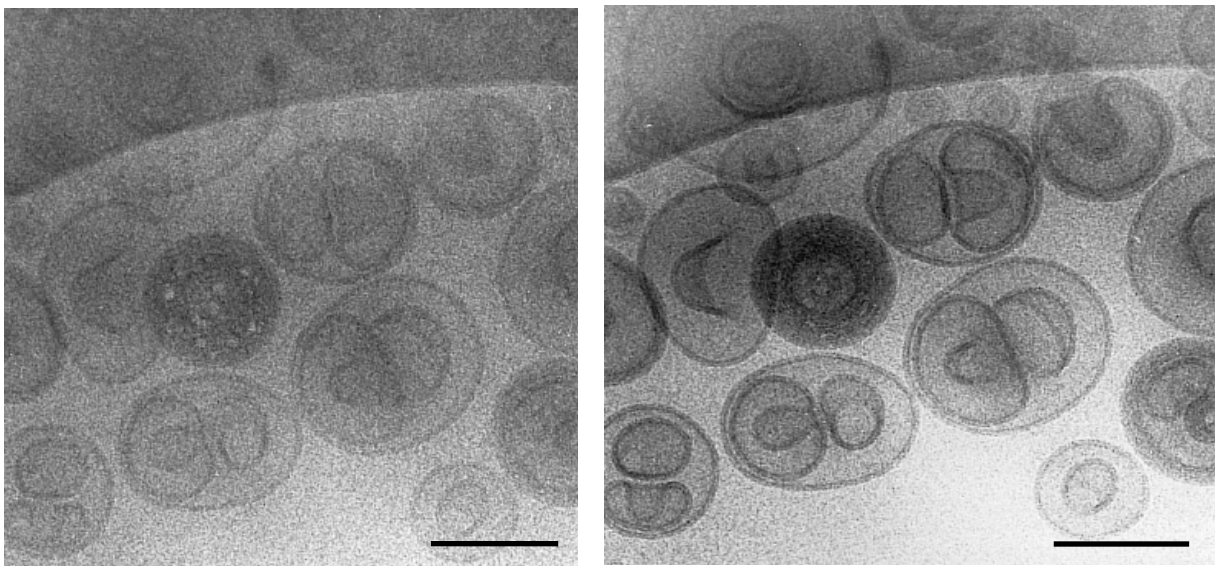


Figure 1. Low dose Cryo-TEM micrographs of block-copolymers, images are zero-loss filtered. Images courtesy of M. Drechsler, E. Egbali & H. Hofmann, Univ. Bayreuth, Germany



Unfiltered image Zero loss filtered image

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

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