

## High Spatial Resolution X-ray Microanalysis of Soft-Matter in the AEM

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Large solid angle x-ray detectors in the Analytical Electron Microscope (AEM) have created opportunities to begin characterizing challenging systems involving soft-matter and/or biological systems including experiments involving cryo-EM configurations [1]. In the past such work has been limited by the poor collection efficiency of the detectors, these experiments generally required excessive electron doses and experienced significant mass loss [2]. Recent experiments have been performed using an FEI Titan AEM, equipped with Super-X and Dual-X SDD systems having large collection solid angles in more robust systems and promising results have been achieved [3]. Multi-frame hyperspectral image measurements were conducted at 200 kV at < 200 pA beam current, dwell times of 100 usec/pixel in a high visibility low background Be holder of 10 nm Ferritin and its oxygen rich sheath on SiNx support film and are illustrated in figure 1. Temporally resolved hyperspectral images confirm no significant mass loss and/or elemental translocation during the in-vacuo measurements [2]. Cryo-EM specimen's provide an additional challenge [4], both in terms of radiation doses and holder/detector geometries. In Figure 2, we illustrate Dual-X hyperspectral imaging of Magnetospirillum Gryphiswaldense (courtesy of D.Schüler, University of Bayreuth), which were plunge frozen using a Vitrobot MarkVI (Thermo Fisher Scientific) and studied in a model 2550 Fischione cryo holder at liquid nitrogen temperatures. Low beam currents of 5 pA at 200 kV were used to minimize beam damage. Fe rich magnetosomes, embedded in the bacteria are clearly discernable. Optimization of the hyperspectral/cryo-EM capabilities is in progress to further improve these capabilities for soft matter research [5].

### References:

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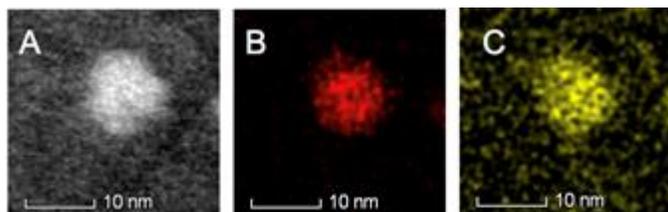


Figure 1.) Hyperspectral images of Ferritin on 20 nm SiNx support film. A) HAADF, B) Iron, C) Oxygen distribution. Note O in the support film is from the SiNx

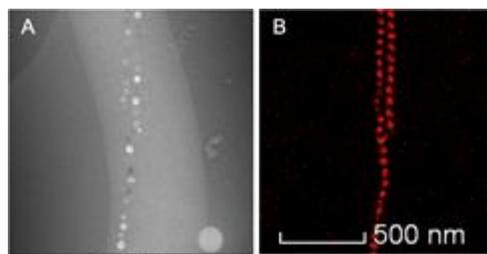


Fig 2.) Hyperspectral images of frozen magnetotactic bacteria, A) HAADF image, B) Iron distributions in a Cryo-TEM holder

