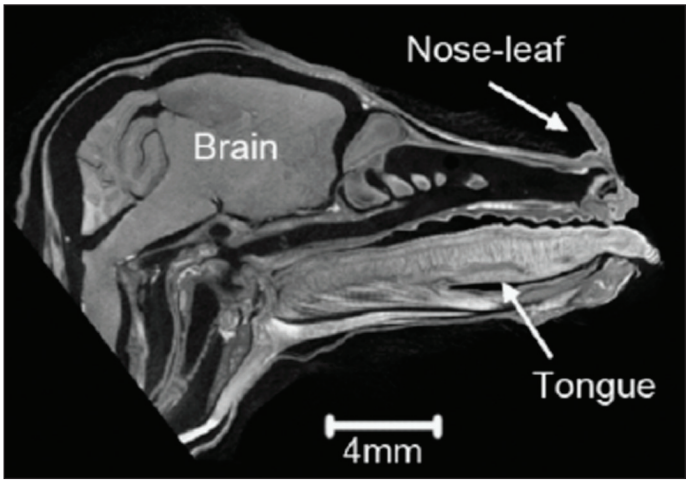
Techniques and Biological Applications

Assessing Soft-Tissue Shrinkage Estimates in Museum Specimens Imaged with Diffusible Iodine-Based Contrast-Enhanced Computed Tomography (diceCT) by BP Hedrick, L Yohe, AV Linden, LM Dávalos, K Sears, A Sadier, SJ Rossiter, KTJ Davies, and E Dumont, *Microsc Microanl* | doi:10.1017/S1431927618000399

Diffusible iodine-based contrast-enhanced micro-computed tomography (diceCT) allows visualization of organismal soft-tissue cheaply and non-destructively, thus giving comparative biologists a new toolkit for assessing morphological variation. As it is impractical to collect fresh specimens, comparative morphologists primarily use museum collections to visualize features across a wide range of species, but the consequences of preparation and storage are not well understood. We report soft-tissue shrinkage in the brains and eyes of five bat species from museum collections and compare this to shrinkage found in specimens of six freshly-collected species. Although the magnitude of shrinkage in the museum specimens did not increase over four weeks of stain time in iodine, the brains and eyes of museum specimens shrank considerably prior to placement in iodine in comparison with field-collected specimens. While the cause of shrinkage in these specimens remains unknown, we caution against study designs that combine fresh and museum specimens. Future work is needed to generate a correction factor that will enable incorporation of museum collections in these studies.



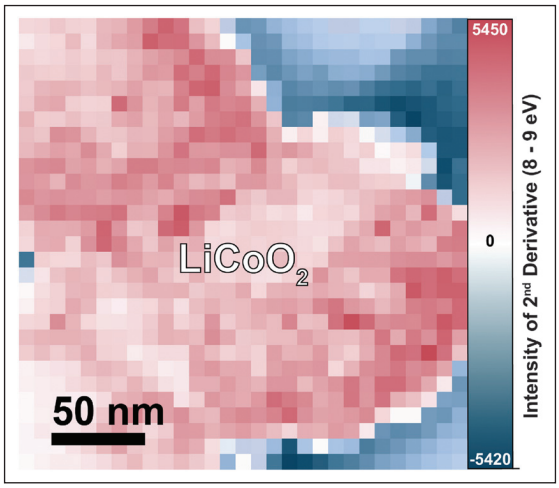
Mid-sagittal section of museum specimen of *Glossophaga soricina* (Pallas's long-tongued bat) head after three weeks in I_2KI stain, demonstrating complete penetration after only several weeks in stain. The black space surrounding the brain shows the degree of shrinkage present in the specimen. Anatomical structures are outlined to orient the specimen. Scale bar = 4 mm.

Techniques and Material Applications

Characterization of Lithium Ion Battery Materials with Valence Electron Energy Loss Spectroscopy by FC Castro and VP Dravid, *Microsc Microanal* | doi:10.1017/S1431927618000302

Electron Energy Loss Spectroscopy (EELS) is an excellent tool for studying lithium ion battery materials (LIB), providing direct information on lithium content, transition metal oxidation state, and oxygen bonding. However, practical EELS analysis can be challenging because of stringent constraints on sample thickness, carbon contamination, and sensitivity to the electron beam.

The valence EELS region (<15 eV) encompasses supplementary features useful for 'fingerprint' analysis and spectrum imaging when facing such challenges. The well-known $LiCoO_2$ cathode, for example, has a notable valence EELS feature from 8–9 eV. This feature has a significantly higher jump ratio than the Li-K edge, enabling analysis of noisy spectra due to a thick sample or minimized electron dosage. Spectrum imaging of this valence EELS feature also yields maps that more accurately represent the morphology and distribution of $LiCoO_2$ particles than mapping of the Li-K edge, especially in thick sample regions. These advantages may be useful for sample quality control, post-acquisition analysis of data, and further developments of LIBs and related energy storage systems.



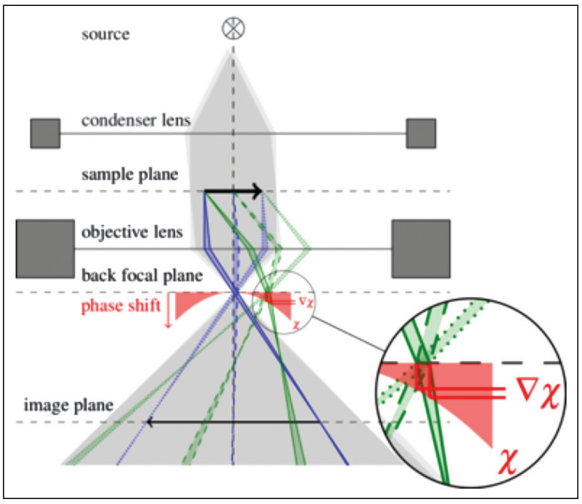
EELS spectrum image of $LiCoO_2$ particles, using the 2nd derivative of the 8–9 eV valence EELS feature. The morphology and distribution of $LiCoO_2$ is accurately shown, even in the center region where the sample thickness is > 200 nm. The spectrum image also distinguishes between $LiCoO_2$ and the underlying carbon support, which is useful when studying materials mixed with carbon compounds for cycling in a battery.

Microscopy AND Microanalysis

Techniques and Material Applications

Electron Source Brightness and Illumination Semi-Angle Distribution Measurement in a Transmission Electron Microscope
by F Börrnert, J Renner, and U Kaiser, *Microsc Microanal* | doi:10.1017/S1431927618000223

Electron source brightness is an important parameter of an electron microscope. Simple and reliable brightness measurement routes are not easily found. A method to determine the illumination semi-angle distribution in transmission electron microscopy is even less well documented. Herein, a facile way to measure the illumination semi-angle distribution and subsequently the electron source brightness in TEM is shown. The basic principle is to evaluate the information limit via Young's fringes tests for different defoci. We found that it is not sufficient to measure just one defocused value, rather it is necessary to include the higher order geometrical aberrations, as well as the other dampening envelope functions into the fit. The measurement method is demonstrated with the help of the SALVE instrument fitted with a FEI X-FEG with monochromator, for which a reduced axial brightness of 1.8 10^8 A/(m^2 sr V) was measured.



Scheme for the illumination dampening mechanism. The gray shading represents parallel illumination originating from two discrete source points and thus shows an angular distribution with just one discrete angle.

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