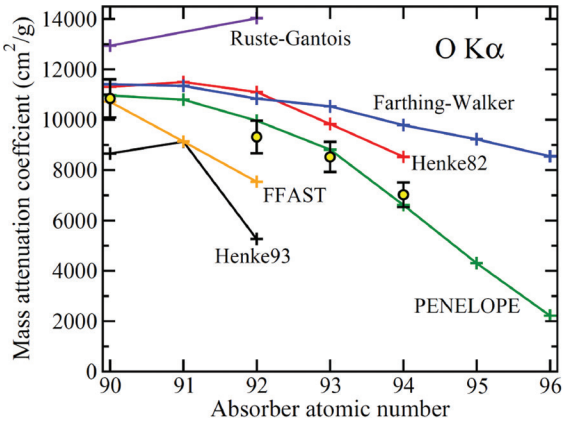
Materials Applications

Determination of Mass Attenuation Coefficients of Th, U, Np, and Pu for Oxygen Kα X-Rays Using an Electron Microprobe by P Pöml and X Llovet, *Microsc Microanal* | https://doi.org/10.1017/S1431927620001282

Electron probe microanalysis (EPMA) is an analytical technique widely used for characterization of nuclear materials. However, accurate analysis of nuclear materials containing light elements (for example, C, N, O) is still difficult because of the large uncertainties affecting the mass attenuation coefficients (MACs) of Kα X-rays of light elements in actinide absorbers. In this study, we performed measurements of the MACs of Th, U, Np, and Pu for O X-rays using a shielded electron microprobe. The MACs were obtained by measuring, at varying accelerating voltages, relative X-ray intensities emitted from ThO_2, UO_2, NpO_2, and PuO_2 targets and processing them with the computer program XMAC. Our results showed that the MACs implemented in the Monte Carlo simulation program PENELOPE, which are based on the photoionization cross-section calculations of Sabbatucci and Salvat (*Rad Phys Chem* 121 [2016] 122–40), provide the best agreement with our measurements (Figure). The PENELOPE MACs consistently yielded accurate EPMA analysis of a uranium-doped americium oxide sample, which also contained Np and Pu.

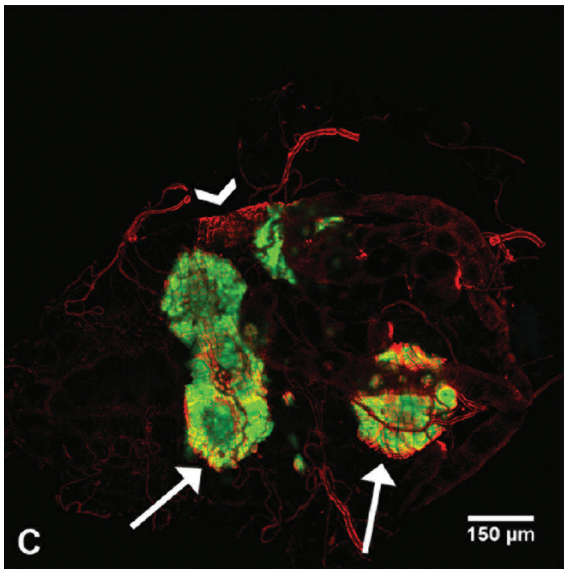


Comparison of tabulated MACs of actinide elements for O Kα X-rays. Solid lines are MAC tabulations from the literature; open circles are the experimental results of the present study. The accuracy of the measured MACs is estimated to be better than 5%.

Biological Applications

Confocal Analysis of Distribution and Persistence of Sindbis Virus (TaV-GFP) Infection in Midguts of *Aedes aegypti* Mosquitoes by JJ Saredy, FY Chim, ZL Lyski, YP Ahearn, and DF Bowers, *Microsc Microanal* | doi:10.1017/S1431927620001270

Biological transmission of arthropod-borne-viruses (arboviruses) to vertebrate hosts by hematophagous insects poses a global threat because such arboviruses can result in a range of serious public health infectious diseases. Female mosquitoes were fed blood containing a virus reporter, SINV (*Thosea asigna* Virus [TaV]-GFP) that produces green fluorescent protein (GFP) in infected cells. The posterior midgut (PMG), an integral organ of transmission, must be breeched before the virus can disseminate to potentially infect the mosquito salivary glands for transmission to vertebrates. Infected PMGs were dissected from viremic blood-fed mosquitoes and labeled with primary antibodies against SINV antigens followed by a secondary antibody conjugated with Texas-red fluorochrome (Figure). The detection of SINV antigens preceded the accumulation of reporter virus GFP. SINV-TaV-GFP was first observed in the PMG, the primary target tissue, at 3 days post-blood-feeding. The virus was sequestered in circumscribed foci and replicated in PMG peristaltic muscles (secondary target tissue) following dissemination. GFP was observed to persist in PMGs for 30 days post-infection.



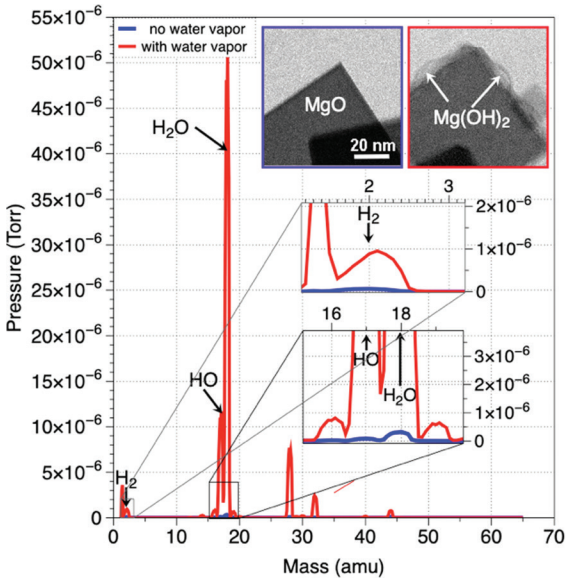
Merged image showing overlap of TX-red labeling of SINV antigens on outskirts of virus foci (arrows) and epithelial cells (arrowhead) prior to robust expression and accumulation of GFP. See Figures 5A and 5B in the published paper for single-channel images.

Microscopy AND Microanalysis

Techniques

Introducing and Controlling Water Vapor in Closed-Cell *In Situ* Electron Microscopy Gas Reactions by KA Unocic, FS Walden, NL Marthe, AK Datye, WC Bigelow, and LF Allard, *Microsc Microanal* | doi:10.1017/S1431927620000185

In situ TEM reactions using an environmental TEM with dry gases are well reported. However, reactions with water vapor using a closed-cell gas-reaction *in situ* holder are poorly understood. Here, we establish protocols for introducing and controlling water vapor concentrations in experimental gases, from 2% at a full atmosphere to 100% at ~17 Torr. Gas composition was measured using a residual gas analyzer (RGA) on the return side of the gas-reactor holder, and changes in the mass spectra with and without water vapor (Figure) were used to correlate dynamic changes in cube-shaped MgO crystals. We showed that interaction of MgO with water vapor results in the formation of surface morphological and chemical changes of MgO, creating a thin, nonuniform, spiky-like surface $Mg(OH)_2$ film. These results provide validation that integrating an RGA with an *in situ* (S)TEM closed-cell gas-reaction system is an invaluable tool to measure gas composition and water vapor content such that correlations between gas composition and dynamic surface reactions can be determined at high spatial resolution.



Mass spectra generated by RGA system on the exit side of the gas cell without water vapor and with flowing water vapor at 16.2 Torr at room temperature and E-chip heated to 250°C, confirming the presence of water vapor.