

Materials analysis by core excitation spectroscopy in a scanning transmission X-ray microscope

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Scanning transmission X-ray microscopy (STXM) is a synchrotron based, soft X-ray spectromicroscopy technique [1] which provides chemical speciation at ~50 nm spatial resolution based on contrast changes associated with differences in X-ray absorption spectra of the species. As with TEM, STXM is a bulk technique but can be used to probe surface interactions if there is sufficient chemical differentiation between adsorbates and substrates. The instrumentation and techniques of soft X-ray spectromicroscopy will be described. STXM can be applied to samples in air, He, vacuum, or in a wet cell with up to 5 microns of water. The performance will be illustrated with applications to analysis of biomaterials [2] (e.g. protein interactions with patterned polymer surfaces – see **Fig. 1**), and soft matter nanotechnology (optimization of self-assembled polymer structures). Recent extension of the technique to examination of samples under potential control (*in situ* electrochemistry) [3] will be described. The advantages (spectral sensitivity, wet cell, lower radiation damage) and limitations (lower spatial resolution, limited complementary analysis) of STXM relative to electron energy loss spectroscopy in present and future (S)TEMs will be discussed.

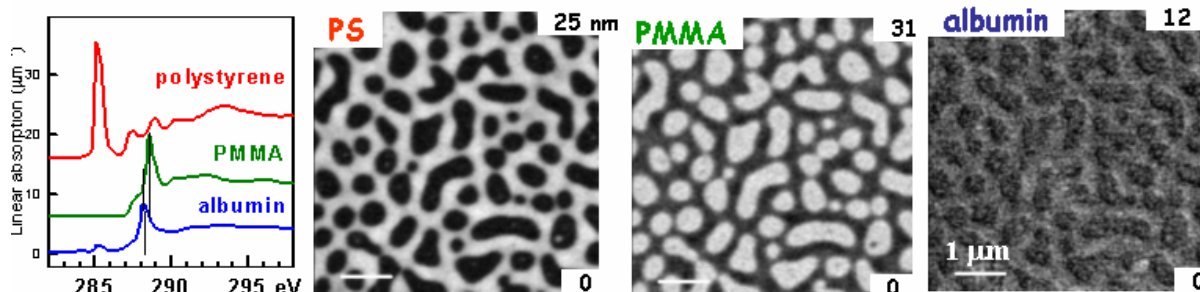


FIG. 1. STXM analysis of adsorption of human serum albumin on a polystyrene – polymethylmethacrylate blend. The polymer substrate (supported on a S_3N_4 membrane) was exposed to a 0.02 mg/ml albumin solution for 10 minutes, then examined by STXM. Transmission images at 63 energies from 282 to 306 eV, with 80 nm pixel spacing were converted to OD, and fit to the 3 reference spectra to generate quantitative chemical maps. From left to right: C 1s spectra of pure components (recorded separately), PS, PMMA and albumin component maps. The upper and lower right hand numbers are the limits of the gray scale indicating thickness in nm.

References

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- [4] Measurements at the Advanced Light Source 5.3.2 STXM. ALS is funded by DoE under contract DE-AC03-76SF00098. Research supported by NSERC (Canada) and the Canada Research Chair program.