Soft x-ray spectromicroscopy of polymer blends and polymer nanocomposites

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For the polymer blend research, chemical sensitivity with sub micron spatial resolution as provided in Near Edge X-ray Fine Structure (NEXASF) microscopy is the key characterization technique. We have been studying a number of polymer blends, including immiscible polymers with inorganic additives, such as nano-clays and carbon nanotubes, and blends exposed supercritical carbon dioxide treatment. All measurements were done at Polymer STXM (Scanning Transmission X-ray Microscopy) station, beamline 5.3.2 at Advanced Light Source. An example of the raw data prior to collapse of the information into a single RGB image is shown in Fig. 1, clearly showing the observed blend morphology in a tertiary PS/PMMA/PVC blend.

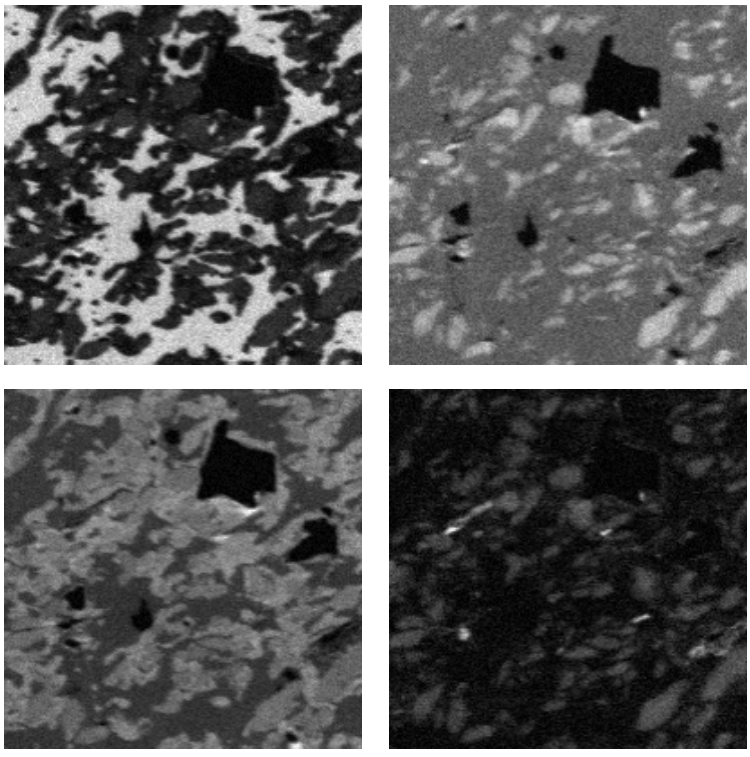

Figure 1: Images show the STXM optical density images of PS/PMMA/PVC polymer blends with nano-clay samples. Each image were taken at the characteristic photon energies for each component (left top : PS, right top : PMMA, left bottom : PVC, right bottom : clay). $(20\ \mu m)^2$, 100 nm/pixel

isuali ation of buried interfacial nanostructures using p otoelectron emission microscopy

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We have performed the visualization and nanospectroscopy (nano-XAFS) of buried interfacial Au nanostructures using hard x-ray photoelectron emission microscopy (PEEM). The hard x-ray PEEM has an advantage of relatively large probing depth with high spatial resolution. The hard x-ray experiments were performed at the undulator beamline BL3 X of the SPring- . The 20 nm thick Au nanostructures covered by a Co capping layer, shown in Fig.1(a), were fabricated by electron beam lithography, Au sputtering, lift-off, and Co sputtering. Figure 1(b) shows the chemical contrast of the buried Au nanostructures with the 50 nm thick Co capping layer observed by hard x-ray PEEM near Au L-edge. The buried interfacial Au nanostructures were clearly imaged for Co capping layers of up to 200 nm. It should be noted that the probing depth of chemical contrast was estimated to be as large as 300 nm, while that of nano-XAFS was 25 nm.

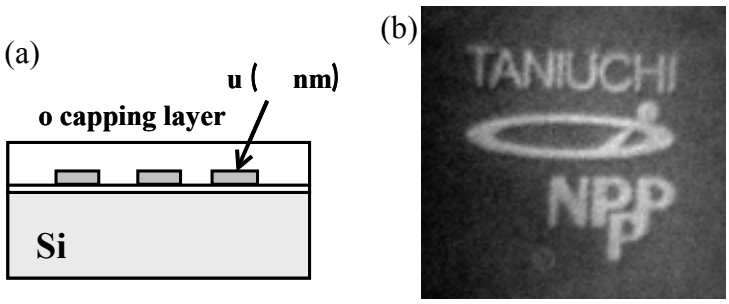

Fig. 1 (a) Cross-sectional schematic diagram of the buried interfacial Au nanostructures. (b) Hard x-ray PEEM image of buried Au nanostructure. The thickness of the Co capping layer is 50 nm.