George Feth – Director Materials & Process Development

Expanding Lab Capabilities at MGV

MGV Enterprises now has a fully operational Electron Microscopy Laboratory. With our new Jeol 1010 TEM (Transmission Electron Microscope) and Gatan 792 Bio Scan Camera we are able to efficiently analyze polymer morphology up to 600,000x magnification.

Samples to be viewed on the TEM are specially prepared on a Leica Ultra Cut UCT. The samples are cut at 50 to 100 nanometers thick, which is .00005 .0001mm just so you have an idea of how thin this is. Then a special stain of Ruthenium (RuO_4) and Osmium (OsO_4) at varying concentrations, exposure time, and temperatures is used to highlight the special features of the specific material to be viewed and analyzed.

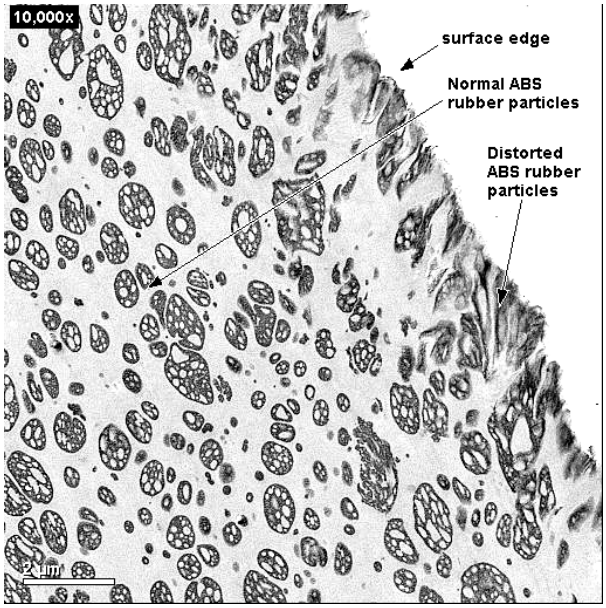
The materials for the TEM must be specially prepared to thicknesses to allow electrons to transmit through the sample, much like light is transmitted through materials in conventional optical microscopy. Because the wavelength of electrons is much smaller than that of visible light, the optimal resolution attainable for TEM images is many orders of magnitude better than that from a light microscope. Thus, TEMs can reveal the finest details of internal structure - in some cases as small as individual atoms. Magnifications of 350,000 times can be routinely obtained for many materials, while in special circumstances; atoms can be imaged at magnifications greater than 15 million times.

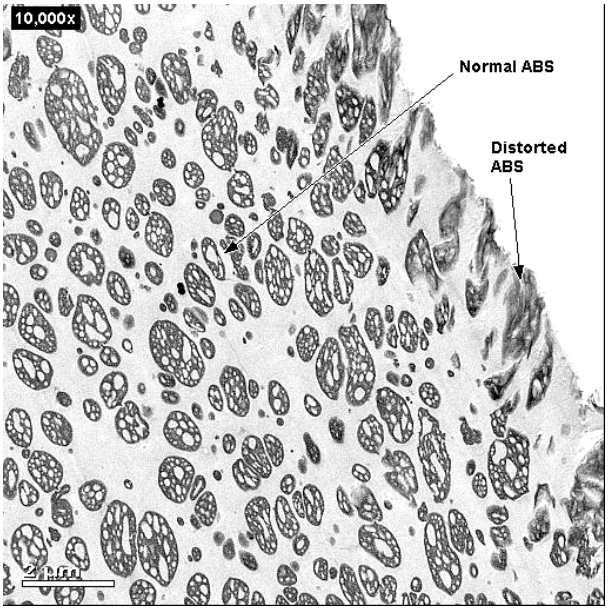
For polymeric materials, phase determination as well as filler orientation are typical outcomes of conventional TEM experiments. The TEM enables us to evaluate the micro structural characterization of nano-filler defoliation, pigment dispersion, rubber phase deformation, as well as the dispersed phase structure. Surface defects such as knit lines, porosity, paint substrate interface, and coating thickness can all be distinguished using the TEM.

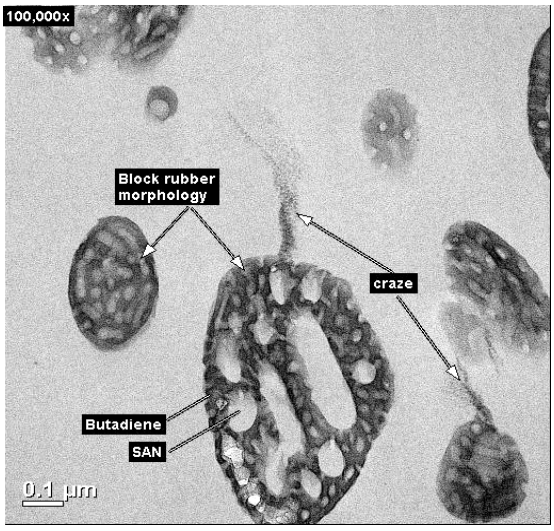
Images obtained from the TEM are two-dimensional sections of the material under study, which is captured with the Gatan digital camera. The scan rate of the camera is adjustable to allow fast navigation about the sample with a high rate of scan, once an area of interest is found a slower more accurate scan rate can be used to capture an accurate representation of the specimen.

With the TEM many polymer processing issues can be evaluated on a molecular level.

TEM cross sections of the splay (white) area show a layer of distorted rubber particles at the surface to a depth of 3 microns. The rubber particles appear to be degraded, stressed and disruptive. They do not exhibit a normal morphology but rather a physically damaged morphology that may be process related from shear forces in the molding process. See Figures 5 & 6







Also, crazing and rubber morphology can be evaluated. This TEM image shows block rubber morphology with evidence of stress by crazing.
SAN domains in some areas appear abnormal.

If you have any questions about Intellimold or our materials and analysis capabilities, feel free to contact us! MGV laboratory services are well known for material and part analysis. See Laboratory

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