Overlay of Laboratory-Based 3D X-ray Imaging Systems.

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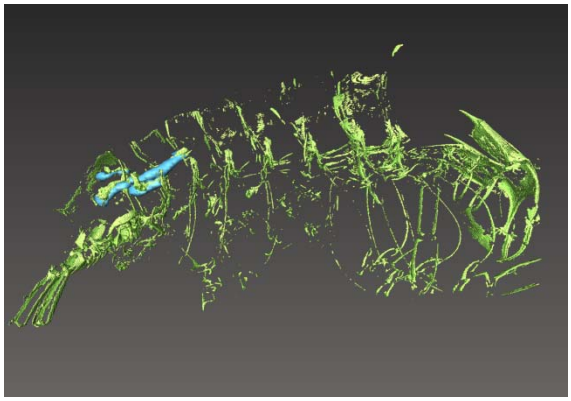
Two important, non-destructive 3D imaging techniques that are used to provide complementary characterization of materials are micro x-ray fluorescence (MXRF) and micro x-ray computed tomography (MXCT). Laboratory-based confocal MXRF and MXCT instruments are used to examine a variety of materials, bulk or structured and finished products. Confocal MXRF uses a broad band x-ray tube source and a fused silica polycapillary to focus the x-rays on the sample. A Si-pin diode detector with a polycapillary is used to collect the fluorescent and scattered x-rays on the detection side. Using an optic on both the source and detector creates a 'confocal' volume which can be rastered through the sample; providing elemental data nondestructively in 3D with a resolution of approximately 30 x 30 x 65 µm. Although the confocal technique is slow, each voxel of data is physically measured and collected successively, a 1-mm volume of data requires approximately 24 hours of instrument time. For confocal MXRF, element specific information is acquired. Micro XCT uses a micro focus x-ray source to shine a cone beam of x-rays through the sample onto a scintillator and a CCD camera. The sample is rotated while radiographs are collected which are then reconstructed into a 3D rendering of the sample. The MXCT technique can provide data sets with sub-micron voxel sizes. However, with MXCT no elemental discrimination of the sample is possible. Using Avizo 6.1, we will demonstrate with several examples the usefulness of applying these two techniques.



One example is of *Leptocheirus plumulosus*, a burrowing amphipod. Trophic transfer experiments are being conducted at Dartmouth College, exposing these creatures to both water and algae with CdSe nanoparticles that the amphipod ingests. The metal is deposited within the body which can be imaged with x-ray techniques. As shown, (right) Se metal nanoparticles, can be imaged (blue) with confocal MXRF and overlaid with a MXCT image (showing high absorbance regions, green). Preliminary indications show the metals do not appear to be deposited elsewhere within the amphipod. Data will be presented showing how the complementary information from each technique provides more comprehensive information on the specimen.