THREE-DIMENSIONAL FT-IR TOMOGRAPHY OF CARBONACEOUS CHONDRITES

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Introduction: Carbonaceous chondrites are highly heterogeneous extraterrestrial samples. Their chemical composition contains variety of organics and minerals of different origin and history. Study of composition of carbonaceous chondrites *in situ* can reveal complex parent body processes and origin of constituents of meteorites, however our knowledge of their formation and processing remains limited. Some organic matter of nebular origin may have formed on mineral grain surfaces, so that a genetic link between the host mineral species and the produced organic matter is highly possible. However, these relations remain poorly understood due to limitations in analytical instrumentation. Study of organic matter and its distribution in meteorites is especially of interest [1, 2]. Furthermore, study of these precious extraterrestrial samples require non-destructive, label-free, and *in situ* investigation in the laboratory. Among available analytical techniques (infrared spectroscopy, Raman spectroscopy, X-ray spectroscopy, NMR, and Carbon XANES), infrared spectroscopy has been the most widely employed technique for the investigation of the chemical composition of extraterrestrial samples. In this work, we employed synchrotron-based three-dimensional microtomography for the investigation of two carbonaceous chondrites, Murchison (CM2), and Renazzo (CR2). This study constitutes the first application of this unique technique to meteoritics for the study of organic-mineral relations as well as their spatial distributions *in situ* within the meteorite grain.

Methods: FTIR spectro-microtomography experiments were performed at IRENI beamline at the Synchrotron Radiation Center, University of Wisconsin in Madison. A single ~40 µm diameter sized Murchison grain was mounted on a sample holder [e.g., 3], which was rotated after each two-dimensional infrared dataset was collected. A total of 224 two-dimensional transmission spectral images were collected, each 128 X 128 pixels spanning the field of view and giving 1.1 µm X 1.1 µm spatial resolution and 8 cm^{-1} spectral resolution. Collected datasets were reconstructed using commercial software packages to obtain three-dimensional spatial distributions of specific molecular functional groups [e.g., 3].

Results: Analyses is currently in progress for the Renazzo grain. Our results for Murchison are as follows. Silicate-rich and silicate-poor regions are distinctly visible in the reconstruction of silicates. Thin layers of CH_3 in aliphatics appear as coarse blobs within the grain. Distribution and grain size of carbonates seem to be similar to that of water. Spectral investigation shows that carbonates are positively correlated with silicates and sulfates.

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References:

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