Transformations of Chromium Speciation Using Synchrotron Radiation Technique in Irrigation-Channel Sediments and Agricultural Soils

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This technique uses synchrotron radiation to photo-ionize the core electrons of Cr atom and provides useful information on the valance of chromium. When the increasing scanning energy is sufficient to eject the core electrons, the energy absorption abruptly increases (absorption edge). With the increasing oxidation state, the absorption edge shifts to higher energies and thus the valence state can be determined. X-ray absorption near edge structure (XANES) spectra of iron samples including metallic Cr and CrO were obtained on the Wiggler beamline at the Synchrotron Radiation Research Center (SRRC) in Hsinchu, Taiwan. The electron storage ring was operated with an energy of 1.5 GeV and a current of 200 mA. A Si(111) double-crystal monochromator (DCM) was used to provide highly monochromatized photon beams with energies of 4 to 15 keV and an energy resolution of 1.9×10−4 (eV/eV). The data were collected in transmission mode with a Lytle detector in the region of the Cr K edge (5989 eV) at room temperature. The absorption spectra were obtained using ion chambers filled with helium gas. The photon energy was calibrated with characteristic pre-edge peaks in the absorption spectrum of an Chromium foil. Each sample had four scans. The fractions of iron species in the samples were deduced using least-square fittings of the XANES spectra. The height and area of the near edge band in the chromium spectrum are quantitatively proportional to the amount of Cr species.

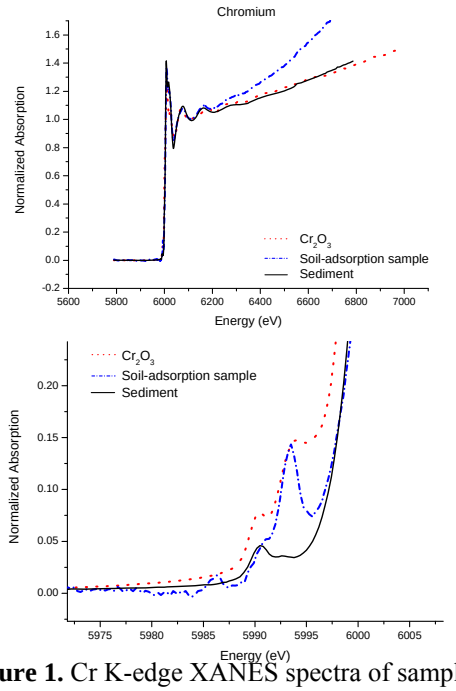

Figure 1. Cr K-edge XANES spectra of samples.

Figure 1 shows results of XANES spectra indicated that Kedge of the chromium atom was 5989eV in the samples. Because of the peak of Cr2O3, can understand that the Cr species in the sediment or soil-adsorption sample were present mostly in trivalent chromium. while availability and mobility of Cr was low, and therefore it would represent a low risk for the environment and human health. Figure 2 shows results of EXAFS spectra analysis indicated that the chromium in the sample of soil profile (0-15cm and 15-30cm) were the same species, and the chromium in other samples were the same species. Results showed that in sediments and soils the Cr species were seem to have different trend.

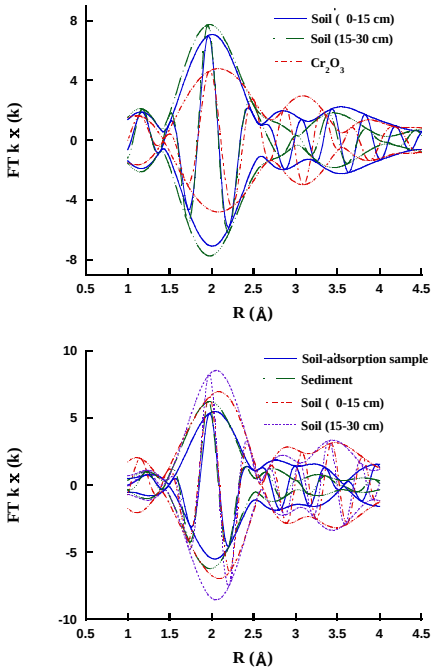

Figure 2. k^3-weighted Fourier transform of EXAFS spectra of samples.