

X-ray Emission Spectroscopy and Electron Microscopy of Mechanically-ground Graphite using Electron Probe Microanalyzer

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Graphite is a material known very well as one form of the allotrope of carbons. Fine particles of graphite has been used as electrode material of the fuel cell or Li-ion battery. It is important to understand the character of the microcrystal graphite to achieve lower internal resistance of the cell and to improve characteristic of the electrical charge and discharge cycle.

As start material, graphite powder on the market was prepared and was mechanically-ground in the argon atmosphere by Spex-8000 mixer mill which is usually used for mechanically-alloying. Processing time was up to 288 k seconds.

The shape of mechanically-ground graphite(MG Graphite) was investigated by a scanning electron microscope(SEM), and crystallinity was analyzed by a X-ray diffractometer(XRD). The characteristics of chemical/electronic state was analyzed by an electron probe microanalyzer(EPMA). Carbon (C) *K*-emission spectra were excited by a 15 keV electron beam and analyzed by a lead stearate pseud multi-layer monochromator. To improve the spectral resolution, 2nd order spectrum was measured.

X-ray emission spectra in *CK* region of MG graphite were shown in Figure 1. They were compared with those of highly oriented pyrolytic graphite(HOPG), carbon-black powder and fullerenes such as C₆₀. The shape of *CK* emission spectra of MG graphite obtained before processing time 32.4 ks was seemed to be simply broadened and the position of their peaks were not changed, and between 18.0 ks and 25.2 ks the spectra looked similar to that of carbon black powder. Details will be discussed.

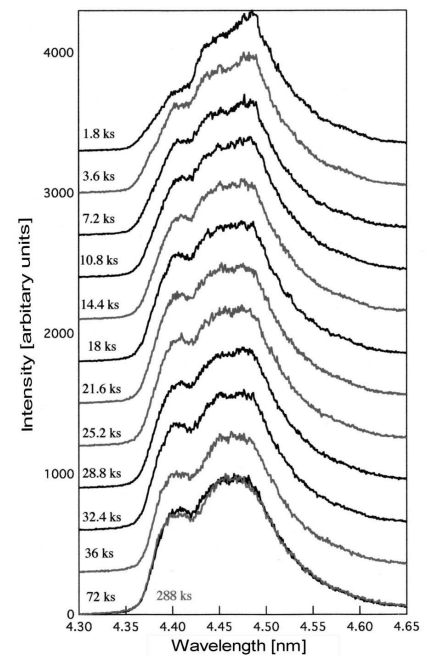


Figure 1: X-ray emission spectra in the *CK* region of mechanically-ground graphite.

References

- 1) Y. MURAMATSU, A. FUJIMOTO, M. YAMASHITA, K. YAMADA, M. MOTOYAMA: Soft x-ray emission and absorption spectroscopy of mechanically-milled graphite and carbon black using synchrotron radiation, The 31th annual meeting of the TANSO ZAIRYO Society, 1-3 December 2004.