Combinatorial XAFS Imaging: Application to efficient screening of CO_2 absorbent

Hiromi Eba and Kenji Sakurai

National Institute for Materials Science (NIMS),Sengen, Tsukuba, Ibaraki 305-0047 JAPAN

X-ray imaging system, which does not need any scans of sample or X-ray beam and therefore dramatically reduces the amount of time required [1], was employed to evaluate combinatorial libraries [2] efficiently. Combinatorial substrate of CO_2 absorbent, lithium ferrite $LiFeO_2$ was prepared, which has 4x4 array of the ferrites synthesized at different temperatures and exposed to CO_2. 2-D XRF (X-ray fluorescence) images of 8 mm ×8 mm area were observed for the substrate by the exposure time of only 3 sec using synchrotron X-rays from BL-16A1, KEK-PF. Thus XRF signals from a whole substrate could be observed at once in a short space of time. In order to see chemical change accompanied by CO_2 absorption simultaneously for each ferrite synthesized at different temperature, fluorescent XAFS (X-ray absorption fine structure) was measured by repeating the imaging during the monochromator scans across the absorption edge for iron. From the amount of spectral change for each ferrite, the performance as CO_2 absorbent could be evaluated, and the best ferrite was selected [3].

This screening procedure is extremely efficient because XAFS spectra for all materials put on the common substrate are obtained from only single energy scan. One can determine the valence numbers and other chemical environment of the metal included in each material, from the differences in spectral features and the energy shifts. Hence combinatorial libraries can be screened very rapidly therefore efficiently using the X-ray imaging system.

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[3] H. Eba and K. Sakurai, Mater. Trans. 46 (2005) 665.