XAFS Analysis of Steel Surface Corroded by Molten Salts

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Introduction

Emission of dioxin from refuse incinerating power plants is a serious matter for man. To reduce its emission the operation of plants at a higher temperature has been recommended. However, the accelerated corrosion of structural steel is a major problem when the plants are operated at a higher temperature. This is because passivation oxides dissolve in eutectic salt melt which comes from fly ash. In order to develop durable material for such plants, it is essential to collect basic data of corroded steel surface. The purpose of the present study is to develop an in site XAFS technique which can be applied to the steel surface covered with molten salt at high temperature. For that purpose a furnace-type conversion electron yield (CEY) cell was designed and constructed. This reports the first results from the apparatus, such as Fe K-edge XAFS spectra for surface of pure iron plates heated up to 873K.

Experimental

The pure iron plate sample was polished with emery paper and washed with methanol. The sample was heated up to 973K and cooled down to room temperature under atmospheric He gas flow. The XAFS spectra were measured at several temperatures during heating process.

Results and Discussion

Figure 1 shows Fe K-edge XAFS spectra of iron sample using our apparatus. Although the first spectrum measured at room temperature indicates that the sample is metallic, others indicate that the surface was oxidized probably due to residual oxygen gas in a CEY cell. When the sample was heated up to 873K from 773K, the spectrum changed, but if it was cooled down to 773K, the original spectrum was recovered. This is because the phase transition of Fe_2O_3 between hematite and maghemite occurred at a temperature between 773K and 873K.

We next tested the furnace type CEY apparatus by introducing steel samples covered with NaCl salt at melting temperature. When sample was introduced together with salts into the furnace type CEY cell, the cell frequently showed electric discharge between electrodes. The present design of in site CEY XAFS cell needs further improvements for such high temperature study.

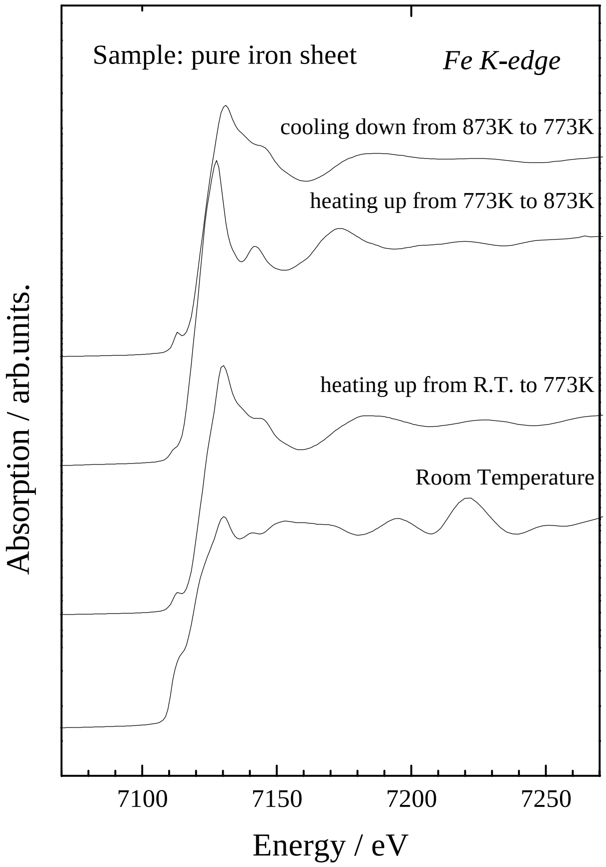

Figure 1 Fe K-edge XAFS spectra of pure iron before and after heat treatments up to 873K.

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