Valence State Mapping of Iron Oxide Thin Film by Signal Processed ESI Series Energy-Loss Image
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For the magnetic materials, the magnetic property is proportional to the angular momentum. In Electron Energy Loss Spectroscopy (EELS), the L ionization edges of transition metal usually display sharp peaks at the near edge region, known as “white line”. The intensities of the white lines, normalized to the trailing background, reflect the filling of the d states [1]. By signal processed electron spectroscopic imaging (ESI) series energy loss image [2], it is feasible to quantitative analysis of two-dimension d states ratio (d²/³/d²/⁵).

A set of signal processing methods comprising fast Fourier transformation interpolation and maximum entropy deconvolution has been successfully integrated to improve the equality of the extracted Fe L-edge spectra from ESI series. Fast Fourier transformation interpolation is used to improve the dispersion arising from discrete sampling of ESI series in the energy space. The maximum entropy method is used to dispel the convolution effect resulting from the ESI series acquired with a finite energy window. Figure1(a) is the TEM image of Fe/α-Fe₂O₃ and Figure 1(b) is the diffraction pattern of α-Fe₂O₃ along the zone axis [10-10]. Theα-Fe₂O₃ was determined in upper layer according the diffraction pattern as shown in the Figure (b). The proposed signal processing methods are applied to extract the d state ratio from the ESI images in theα-Fe₂O₃. Figure2 is the flow chart of signal processing procedures for reconstructing ESI spectra. The ESI images are acquired from 680eV to 780eV, the energy slit is 4eV and the step is 2eV, shown as Figure3 (a). Figure 3(b) and 3(c) are the spectrums extracted fromα-Fe₂O₃ and Fe respectively. The L3 and L2 peaks are visible in the spectrum.

The advanced results will present in the conference.

Reference
Fig. 1(a) TEM image of the Fe/α-Fe₂O₃. Fig. 1(b) The diffraction pattern of α-Fe₂O₃.

Fig. 2 A flow chart of signal processing procedures for reconstructing ESI spectra.

Fig. 3(a) The ESI images acquired from 680eV to 780eV. Fig. 3(b) and Fig. 3(c) are the spectrum extracted from α-Fe₂O₃ and Fe respectively.