PA04

INVESTIGATION OF VERWAY TRANSITION OF MAGNETITE IN A TRANSMISSION ELECTRON MICROSCOPE

Ping-Luen Ho[1], Xiaoyan Zhong[1], Zi An Li[4], Joachim Mayer[2,3] and Rafal E. Dunin-Borkowski[2]

[1]National Center for Electron Microscopy in Beijing, Key Laboratory of Advanced Materials (MOE), The State Key Laboratory of New Ceramics and Fine Processing, School of Materials Science and Engineering, Tsinghua University, Beijing 100084, China
[2]Ernst Ruska-Centre for Microscopy and Spectroscopy with Electrons and Peter Grünberg Institute, Research Centre Jülich, 52425 Jülich, Germany
[3]Gemeinschaftslabor für Elektronenmikroskopie(GFE), RWTH Aachen, Ahornstraße 55, 52074 Aachen, Germany
[4]Institute of Physics, Chinese Academy of Science, Beijing 100190, China

Abstract

Ferromagnetism shows various phenomenon at low temperature. The story of the Verwey transition in magnetite have been investigated over a period of about one century. Magnetite was observed the rapidly rising of heat capacity by Verwey found less than 125 kelvins degree for first time, and also its captivity and resistivity were changed significantly.[1] Along with the progress of advanced materials characterization methods, more research groups have a new interpretation to explain the magnetic performance of Fe_3O_4.[2]

This report focuses on the dynamical evolution of crystallographic structure of magnetite during magnetic phase transitions at low temperatures. The changes in morphology and diffraction patterns of magnetite along zone axis [011] were continuously recorded around Verwey temperature by in-situ transmission electron microscopy. The heating effect of electron beam was also confirmed in the in-situ experiments.

In the future, we would like to compare magnetic structure of magnetite below Verwey temperature with that at room temperature by using electron energy-loss magnetic chiral dichroism (EMCD). EMCD shows its unique capability to quantitatively determine the element specific spin and orbital magnetic moments at different sites at the nanometre scale.[3] It might enable us better understand the relationship between crystallographic structure and magnetic structure during the Verwey transition of magnetite.

[1] Verwey E. J. W., Haayman P. W., Physica, **8** (979), 1941.
[2] F. Walz, J. Phys. Cond. Matter, **14**, R285, 2008.
[3] Z. Q. Wang et al, Nature comm., **4**, pp 1395-1400, 2013.