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XAFS STUDY OF SURFACE OXIDISED Fe PARTICLES

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A study of surface oxidised iron particles by means of X-ray Absorption Spectroscopy (XAS) at the Fe K, $L_{2,3}$-edges and the O K-edge is presented.

Powder samples were prepared by ball milling and subsequently thermally treated in vacuum or air. The XAS study of the samples and the reference Fe oxides in the XANES range of the Fe K-edge has been carried out at the synchrotron laboratory HASYLAB, Hamburg. Simultaneous measurements in the transmission geometry and total electron yield (TEY) have been carried out. The transmission spectra which correspond to probing of the bulk do not reveal the presence of iron oxides within 1% error margin, except for the sample annealed in air at 300°C. Its spectrum consists of the contributions of 95% metallic Fe, 4% magnetite and 1% hematite. The TEY spectrum of the sample, which corresponds to a few hundreds of nanometres probing depth, contains contributions of 45% metallic Fe, 42% magnetite and 13% hematite. Taking into account different probing depths of both methods the average thickness of the oxide layer could be determined.

The XANES spectra of the samples studied and the reference oxides at the Fe $L_{2,3}$-edges, O K-edge and the EXAFS spectra at the O K-edge have been measured at the synchrotron laboratory ELETTRA, Trieste. The TEY detection mode was used, which in the case of the iron $L_{2,3}$-edges and the oxygen K-edge has the probing depth of a few nanometres.

The O K-edge XANES spectra and their derivatives as well as the EXAFS spectra have been fitted with a linear combination of the spectra of the reference oxides. This provided the information on the content of individual oxide species in the surface layers, which is particularly valuable for the samples thermally untreated and annealed in vacuum, where the oxide layer is of nanometric thickness. A relation of the content and thickness of the oxide layer to the magnetoresistive properties of the material is discussed.

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