

Phase visualization in multiphase steel by scanning electron microscopy at near zero eV

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Recent results regarding to a scanning electron microscopy (SEM) at near zero eV will be presented after a brief introduction about JFE Steel Corporation and our activities in characterization and analysis. In recent years, microstructures in steel have become more complicated and they are very important rolls for their mechanical properties. In this talk, I will show an observation technique by super low energy (SLE) SEM at below 5 eV and explain its contrast mechanism for analyzing complex microstructures of a multiphase steel consisting of ferrite, martensite and austenite. With SLESEM at 1 eV, these three phases were observed as different brightness levels; ferrite as the darkest contrast, martensite as the second brightest and austenite as the brightest. These contrasts disappeared at 2 eV or higher landing energy. Similar contrasts and phenomena were also observed in the results of a low energy electron microscopy (LEEM) observation. According to the energy dependences of the LEEM intensities of the three phases, threshold energies of the transition from electron reflection to surface impact were determined to be 0.00 eV, 0.15 eV and 0.39 eV for ferrite, martensite and austenite, respectively. Therefore, it is considered that the mechanism of contrast is due to differences in the surface potentials. The origin of the surface potentials are probably due to contact potentials generated when phases with different work functions contact each other. It is also supposed that the surface potentials can affect to incident electrons through the native oxide layer and adsorbed molecules on the sample surface.



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