

EDGE MEETING ABSTRACT SUBMISSION FORM

Oxidation kinetics of nickel particles by EELS in an environmental TEM

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The mechanisms controlling the growth of an oxide film during oxidation are subject to controversies at intermediate length scales (20-1000 nm) [1]. Nickel particles are oxidized under 3.2 mbar of O₂ inside an environmental TEM (ETEM) equipped with a post-column filter [2]. Images, diffraction patterns and core-loss electron energy-loss spectra are acquired to monitor the structural and chemical evolution of Ni during oxidation, whilst increasing the temperature up to 600 °C. The reaction kinetics are inferred by EELS using different techniques analyzing changes in shapes of the Ni L_{2,3} white lines [3]. The results indicate, in accordance with the TEM observations, that the oxidation process is diffusion-controlled. From STEM-HAADF images, it can be further deduced that Ni²⁺ diffusion through the NiO film controls the reaction in these conditions. An activation energy for Ni oxidation comparable to the ones found in the literature is determined from our EELS data.

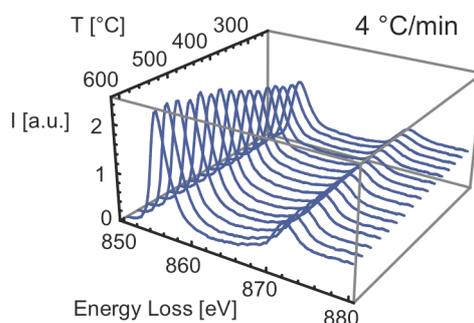


FIG. 1. Evolution of background-subtracted electron energy-loss spectra acquired as a function of temperature for a 4 °C/min ramp, with one spectrum acquired every 6 minutes (corresponding to 24 °C). Similar profiles are acquired at 2 and 6 °C/min to deduce the oxidation kinetics. The spectra are normalized to 1 at L₂.

References

- [1] A. Atkinson, *Reviews of Modern Physics*, 57 (1985) 437.
- [2] T.W. Hansen, *et al.*, *Materials Science and Technology*, 26 (2010) 1338.
- [3] Q. Jeangros, *et al.*, *Journal of Materials Science*, 48 (2013) 2893.
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