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Monitoring the dynamics of Kirkendall effect in Cu nanoparticles with LSPR spectroscopy in ETEM

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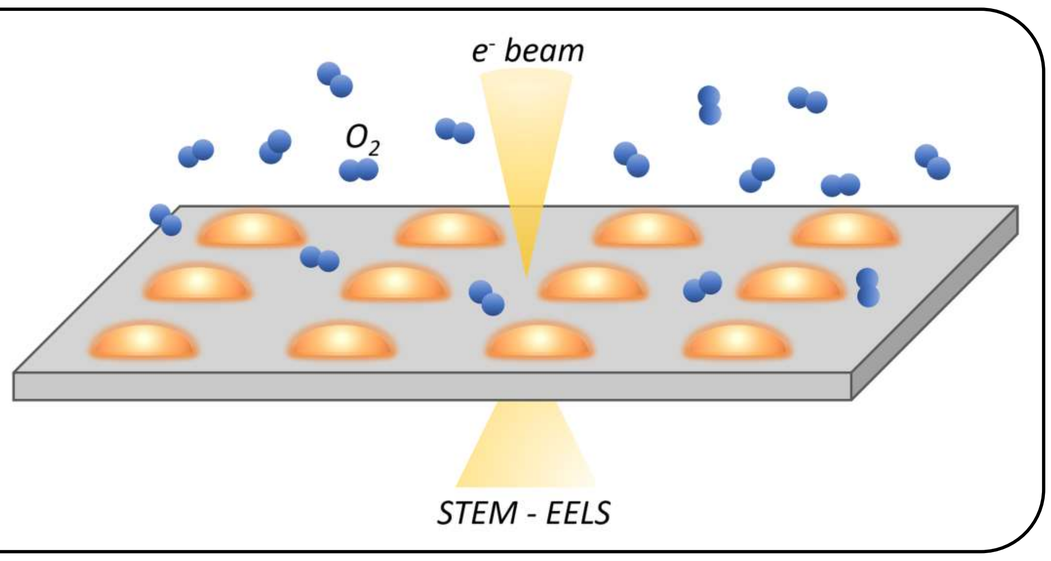
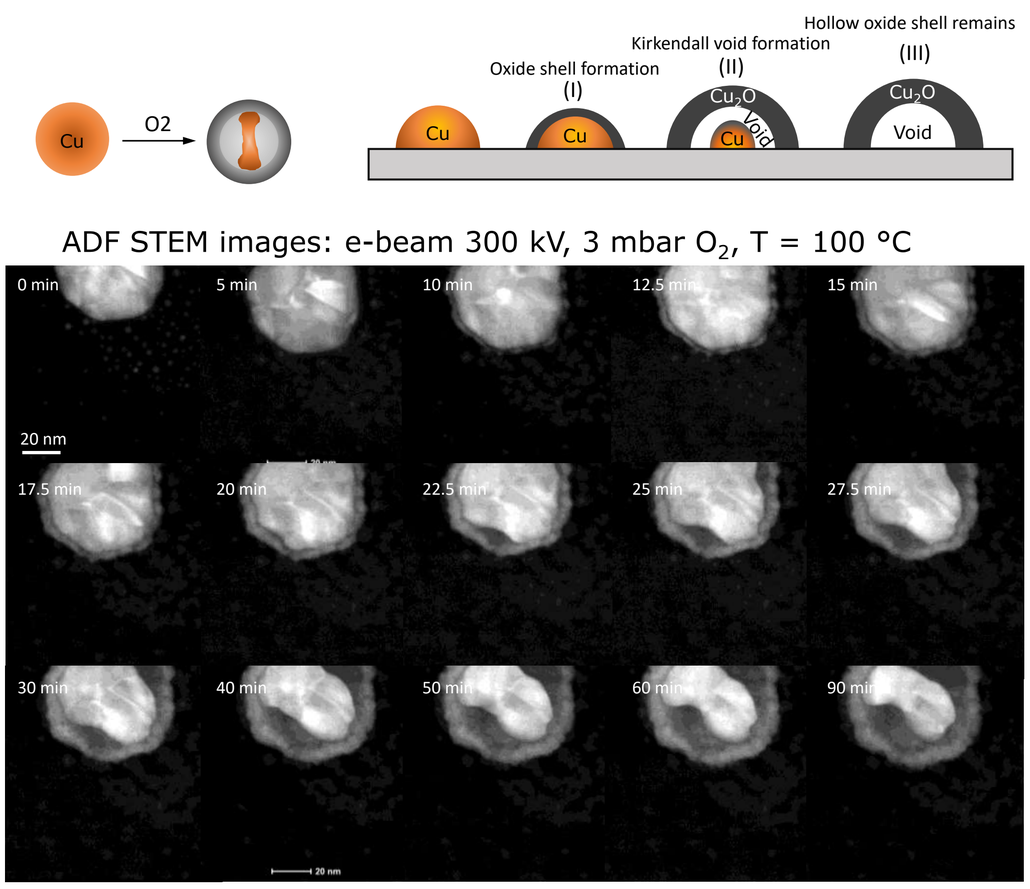
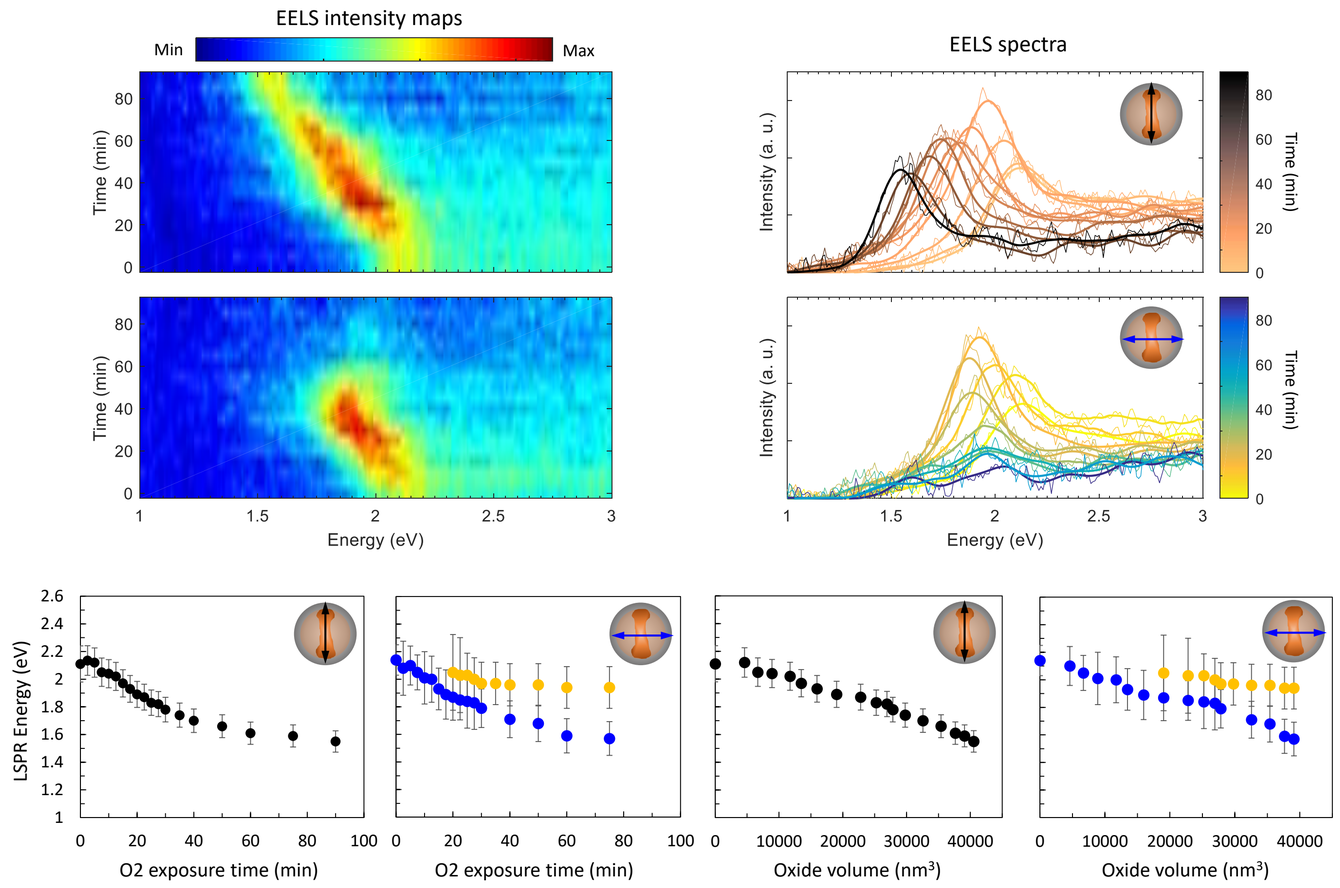
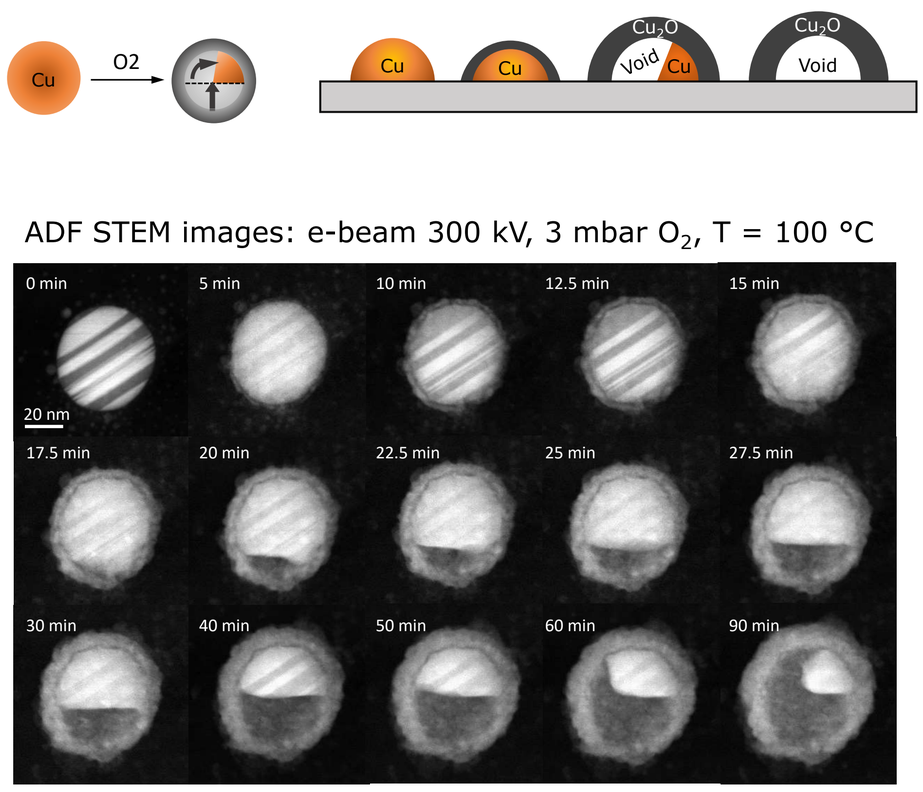
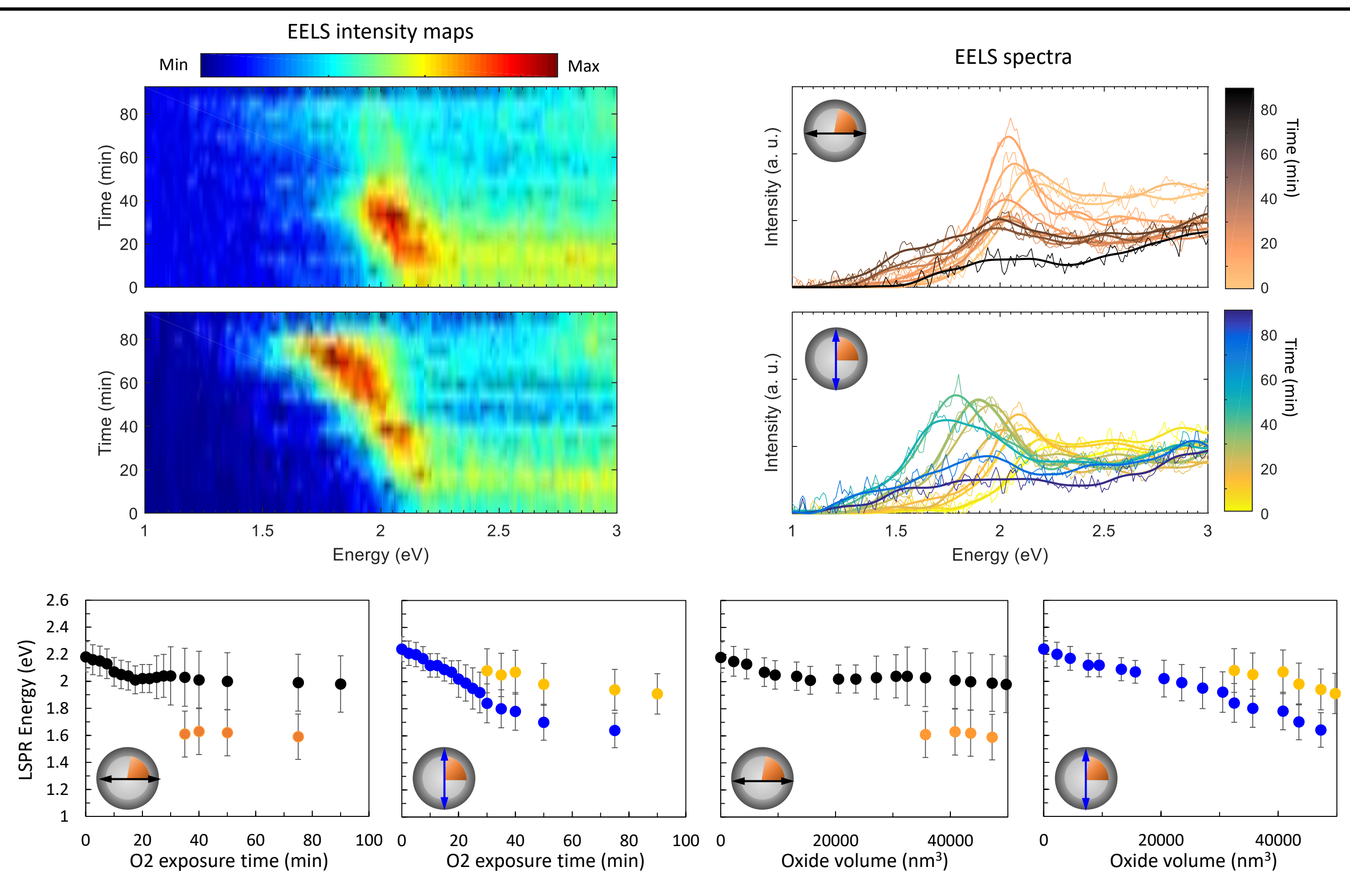
Studying the oxidation process in Cu nanoparticles is relevant for a number of applications, including microelectronics, catalysis, plasmonics and photovoltaics. Here we use environmental transmission electron microscopy (ETEM) to monitor *in-situ* the changes occurring to Cu nanoparticles and their localised surface plasmons (LSPRs) during oxidation. Annular dark-field scanning TEM (ADF STEM) imaging is employed to closely examine the dynamics of metal to oxide conversion and electron energy-loss spectroscopy (EELS) is employed to follow the evolution of the LSPRs of the particles.











Summary and future work

- *In-situ* STEM imaging of Cu nanoparticles during oxidation reveals the details of their Kirkendall oxidation mechanism.
- *In-situ* monitoring of the LSPR shows red-shift of the peak energy followed by broadening and splitting of the LSPR peak into two before complete loss of the signal at the final stage of oxidation. The extent of these features shows dependence on the position of the electron probe relative to the nanoparticle. This implies the possibility of using the LSPR energy, intensity and line-width of Cu nanoparticles at different light polarisations to predict their morphology and composition during oxidation.