

Moving atoms imaged with aberration corrected focal series

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Introduction

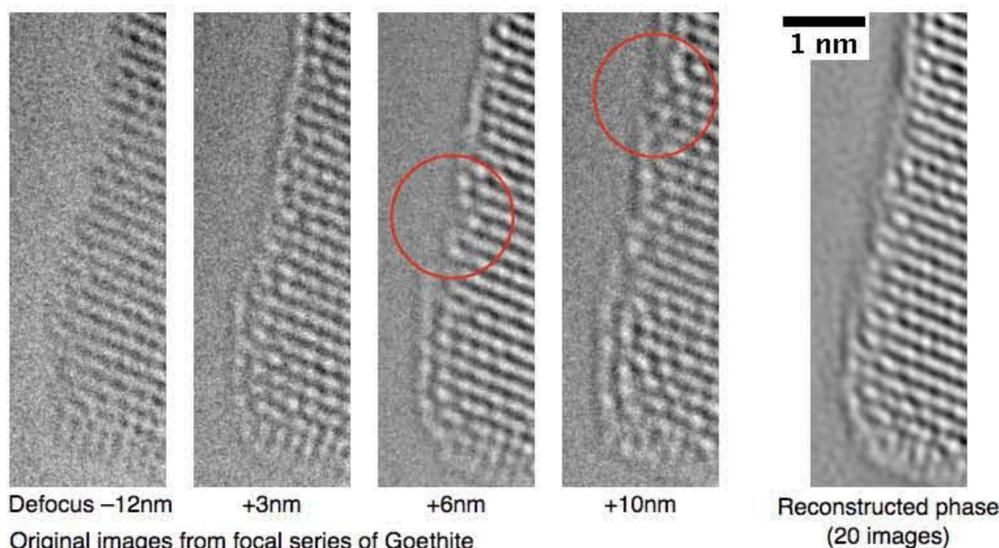
Aberration corrected focal series reconstruction allows us to image individual atomic columns in many structures.

For reliable reconstruction the structure must remain the same throughout the focal series. But for many materials we find there are considerable structural changes between each image in the series.

Aberration corrected focal series reconstruction provides a means to study these changes.

All aberration corrected images were taken at 200kV on the JEOL 2200 FEGTEM at the Department of Materials, Oxford University.

Goethite, FeO(OH)

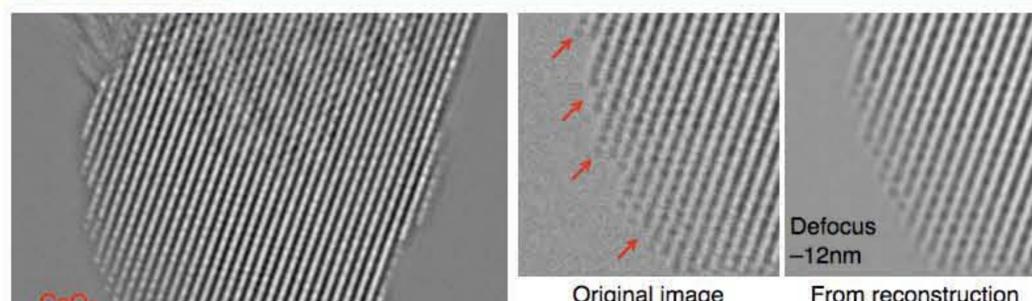


Original images from focal series of Goethite

Reconstructed phase (20 images)

Atomic rearrangements are visible throughout series, especially in the circled areas

Au on CeO₂



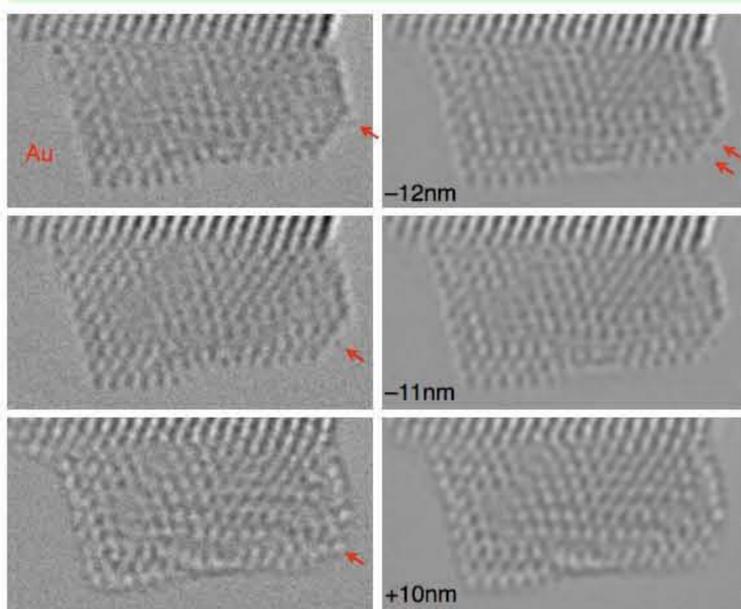
Reconstructed phase (20 images).

Atomic columns at edge of CeO₂ look very plausible...

...but comparison of original image (above left) with image calculated from reconstruction (above right) shows atomic rearrangements (arrows).

The reconstructed phase shows the *average* positions of the atomic columns over the focal series.

Au on CeO₂



Original images

Calculated from reconstruction

Atomic rearrangements along row of Au atoms.

One moving Au atom in original images (arrows).

Two atoms in reconstruction (arrows).

Conclusions

The wavefunction recovered using focal series reconstruction is an average of the images in the focal series. It will not be valid if there is atomic rearrangement during the series.

Atomic motion can be determined from individual members of a focal series either by comparison with other members or by comparison with images calculated from the restored wavefunction.

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