HENRY ROYCE INSTITUTE

UNIVERSITY OF OXFORD

Department of Materials

APPLICATIONS NOTE

JEOL 4D Canvas fast camera on S/TEM

The JEOL 4D canvas has applications in many fields, including nanoscience, energy materials and biosciences. The 4D Canvas fast camera is installed in an aberration-corrected scanning transmission electron microscope (STEM).

Quantitative imaging of light elements at atomic resolution

The addition of this detector allows low-noise atomic resolution phase images to be produced even for the lightest elements. Low beam intensities can be used, to minimise sample damage.

Simultaneous imaging of light and heavy elements

By combining signals from two detectors, both light and heavy element structures can be characterised — at atomic resolution.

Post-processing to correct image imperfections

Rich data supports the post-processing of images. This helps to prevent damage to the material and increases sample throughput.

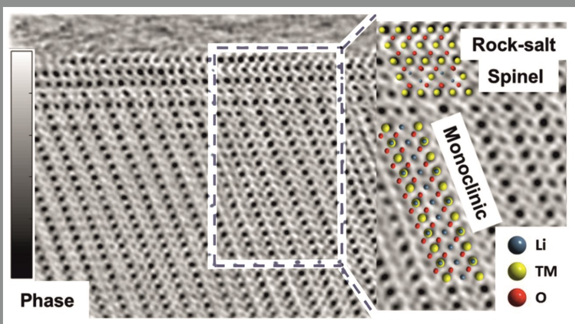
JEOL 4D Canvas

Fast pixelated detector addition to scanning transmission electron m

Low-noise atomic resolution phase images of light elements, with lo

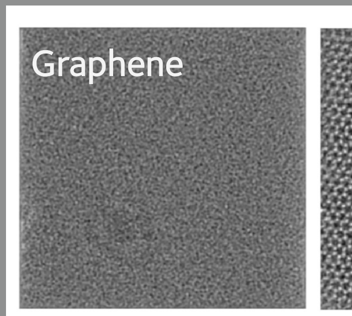
Analysis of battery materials [1]

Damage-free atomic-resolution phase imaging of oxygen and lithium atoms has allowed structural changes to be observed after cycling or degradation.



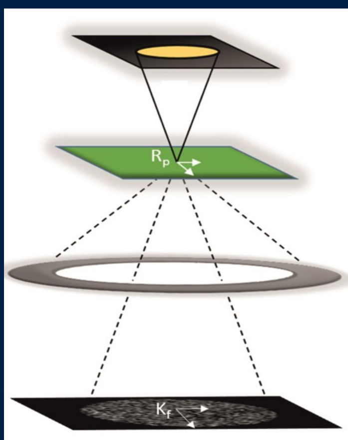
$Li_{1.2}Mn_{0.6}Ni_{0.2}O_2$

Image correction aft



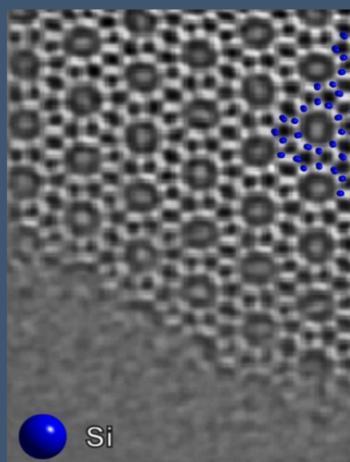
Raw image C

Schematic of STEM with 4D Canvas



Zeolite structure iden

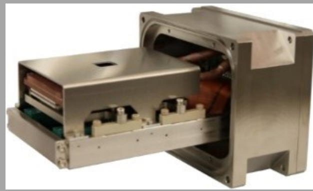
Applying phase imagi Canvas detector data of ZSM-5 zeolite has



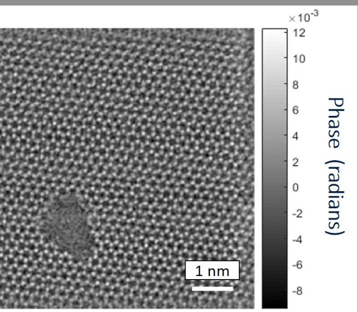
[1] Lozano et al., *Nano Lett.*, 18, 6850-6855 2018 [2] O'Leary 2018 [3] O'L

nicroscope (STEM)

ow probe beam intensities



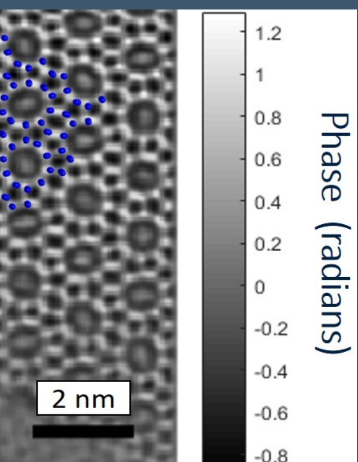
er data acquisition [2]



orrected image

ntification [3]

ng to low-intensity 4D , the atomic structure been resolved.

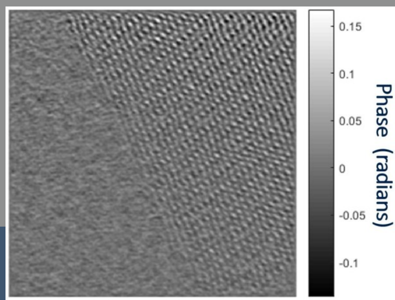


Imaging polymer crystallinity [4]

Low-dose phase imaging has revealed information crucial to understanding of polymer crystal structure.

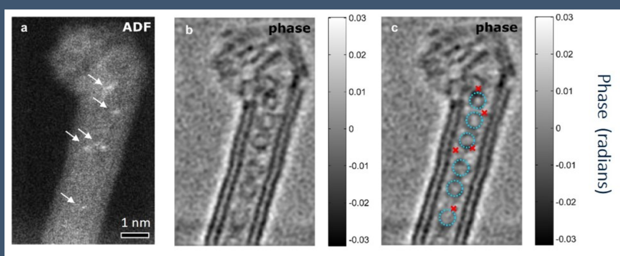
PEN

Polyester

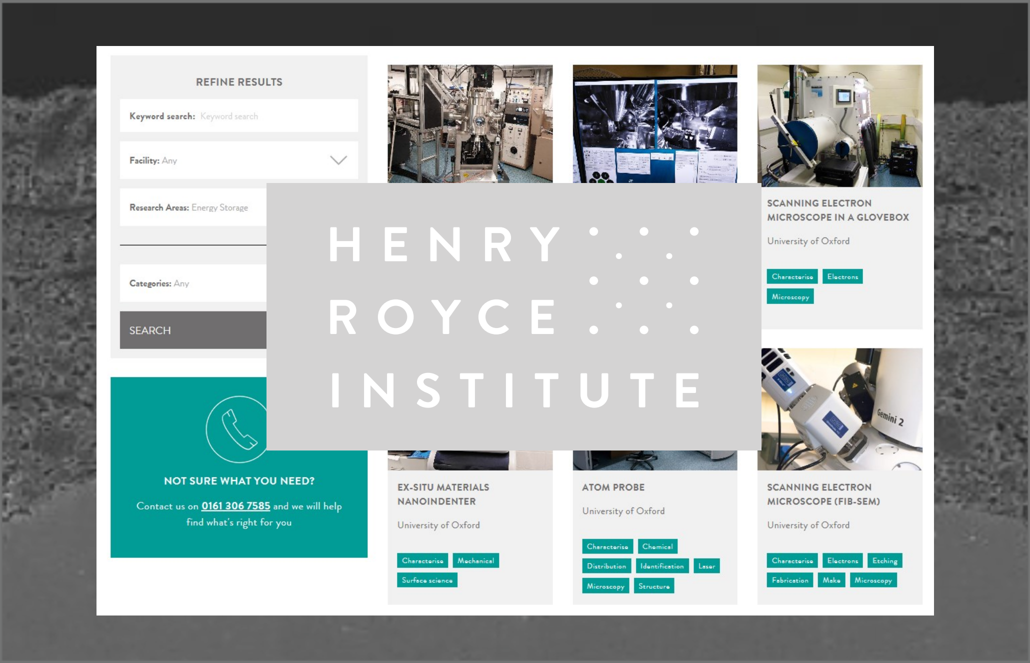


Simultaneous imaging: light and heavy elements [5]

Image showing the position of iodine atoms (left); image of fullerenes and carbon nanotubes (centre); composite image (right).



Leary 2019 [4] Lou 2019 [5] H. Yang et al., *Nat. Commun.*, 7, 12532, 2016



Henry Royce Institute, the UK's national institute for materials science research and innovation, is home to advanced capabilities across nine leading materials research institutions: Universities of Oxford, Cambridge, Imperial College London, Liverpool, Leeds, Sheffield, the hub at the University of Manchester; together with UKAEA and the National Nuclear Laboratory. All Royce-supported and -funded equipment is available for external academic and industrial use.

University of Oxford leads on energy storage activities within the Royce.

At Oxford, the **Department of Materials** hosts a suite of state of the art facilities and equipment. Investment through the Royce contributes to the focus on analysis of energy materials and development of next generation energy storage solutions.

Capabilities at Oxford are backed up by scientists based in the **David Cockayne Centre for Electron Microscopy**, the **Oxford Materials Characterisation Service** and the **Atom Probe Group**, along with the battery research groups of **Professors Peter Bruce, Patrick Grant, Mauro Pasta** and **Rob Weatherup**.

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