and then treating the solution with visible light.

"Understanding why the photoreaction is so strongly perturbed by incorporation of the ligand into the MOF is critical to controlling the photoreactivity of these materials," explains Benedict. As well as cracking this puzzle, his team are also planning to design new photoresponsive ligands and incorporate them into MOF structures that are ready known to have desirable properties, with the hope of rendering these properties externally controllable.

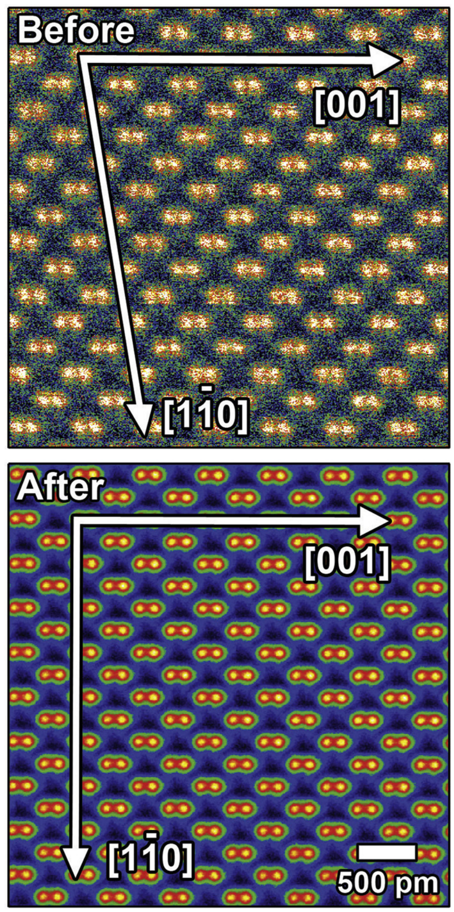
Nina Notman

Stabilized microscopy

Eliminating distortion from nanoscale scanning transmission electron microscope (STEM) images is now possible thanks to researchers at North Carolina State University. When taking snapshots of samples just a couple of dozen nanometers across, even the tiniest movement can lead to a distorted image, this is exacerbated by the fact that a STEM scan can take tens of seconds to carry out. Think of trying to write a sentence on a moving sheet of paper; the result is unintelligible.

Materials scientist James LeBeau and his colleagues point out that minute changes in ambient temperature also cause microscopic expansions and contractions of the sample support rod and these too lead to movements that distort the final image. LeBeau and his colleagues have developed an approach – RevSTEM – that effectively eliminates the effect of such drift on STEM images, he says [J. LeBeau, et al. Ultramicroscopy 138 (2014) 28–35].

The technique involves programming the STEM instrument to rotate the direction in which it scans the sample. For example, it might first take an image scanning from left to right, then take one scanning from top to bottom, then right to left, then bottom to top. Each scanning direction captures the distortion caused by drift from a different vantage point.



The researchers then feed those images to their computer and their software measures the features in each image, compares them and works out the precise drift experienced by the sample. With the pattern of drift quantified, the movement can then be subtracted from the optimal image to give a distortion-free view of the sample. The resulting images accurately represent the actual structure of the sample and give scientists new capabilities to understand bonding between atoms, the team says.

"Historically, a major problem with drift has been that you need to have a reference material in any nanoscale image, so that you can tell how the image has been distorted," LeBeau explains. "Our technique makes that unnecessary. That means we can now look at completely unknown samples and discover their crystalline structures, which is an important step in helping us control a material's physical properties." The team concludes that the approach dramatically improves signal-to-noise ratio and allows them to attain picometre precision and accuracy regardless of drift rate.

"The next step is the application of the technique to answer a variety of materials science questions in important area ranging from defect phenomena to local unit cell scale structural distortion," LeBeau told *Materials Today*.

David Bradley

High-resolution X-ray holograph on the deck

Recording high-resolution, X-ray holographic snapshots of dynamic processes is now possible thanks to Stefan Eisebitt of Technische Universität Berlin and colleagues there and at Helmholtz-Zentrum Berlin (HZB). Their approach relies on firmly fixed optics and computer power to extract the three-dimensional holographic information and focus the image [Eisebitt, et al., Nat. Commun. (2014), doi:10.1038/ncomms4008].

X-ray holography requires a coherent source, such as that available with the synchrotron source BESSY II. A sample is bathed with incident X-rays while a pinhole taps off a reference wave. Researchers can then create a hologram by superposing the two waves on a detector, data from which is fed to a computer for conversion into an image. Of course to be focused, the pinhole aperture must be very small, which means lower contrast in the resulting hologram.

Eisebitt and his colleagues have sidestepped this problem by swapping the pinhole for another optical element, a Fresnel zone plate. This is placed in the plane of the object and significantly increases the brightness of the reference wave. However, because the zone plate's focal point is itself not in the plane of the object (contrast the pinhole aperture), the image obtained is out of focus. Luckily, the holographic information allows any focal plane to be chosen and the image "sharpened" photographically speaking. The improved efficiency of the method means short exposure times and low contrast samples can be used as well fast dynamic processes studied.