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Cornell researchers use ptychography to obtain the world's highest resolution images

Researchers at Cornell University have used ptychography to achieve the highest resolution ever produced in an electron microscope. The team, led by David Muller, Professor of Applied and Engineering Physics, recently reported their findings in the July 19th issue of Nature [1], outlining their ability to resolve images to a resolution of 0.39 Å. This level of resolution has enabled them to visualise individual atoms with greater contrast, and less damage than was previously possible. To put their achievement into perspective, it represents a 2.5x improvement over the conventional imaging performance of their microscope.

Ptychography is a computational imaging technique that utilises sophisticated algorithms to reconstruct an image from overlapping diffraction patterns, created when an object is illuminated. In their paper, Muller's group use a powerful new electron camera, which they have developed, to record the diffraction patterns with exceptional sensitivity, speed and dynamic range. The world-record resolution was made possible by the combination of detector and ptychography, heralding a new era in electron microscopy.

Phasefocus™ has commercialised ptychography as its proprietary platform technology, creating a portfolio of products to accommodate a wide range of imaging applications, encompassing life science, healthcare, engineering, metrology and more.

The Phasefocus πbox reconstruction engine, suitable for electron microscopy, is a back-end processing platform that can be connected to a microscope, network or cloud based, to deliver reconstructed ptychographic images to the user's own software.

Compatible with electrons and any electromagnetic wave, πbox deciphers raw diffraction patterns to streamline image generation, making it applicable across a wide range of imaging modalities including X-ray, Electron microscopy and optical microscopy.

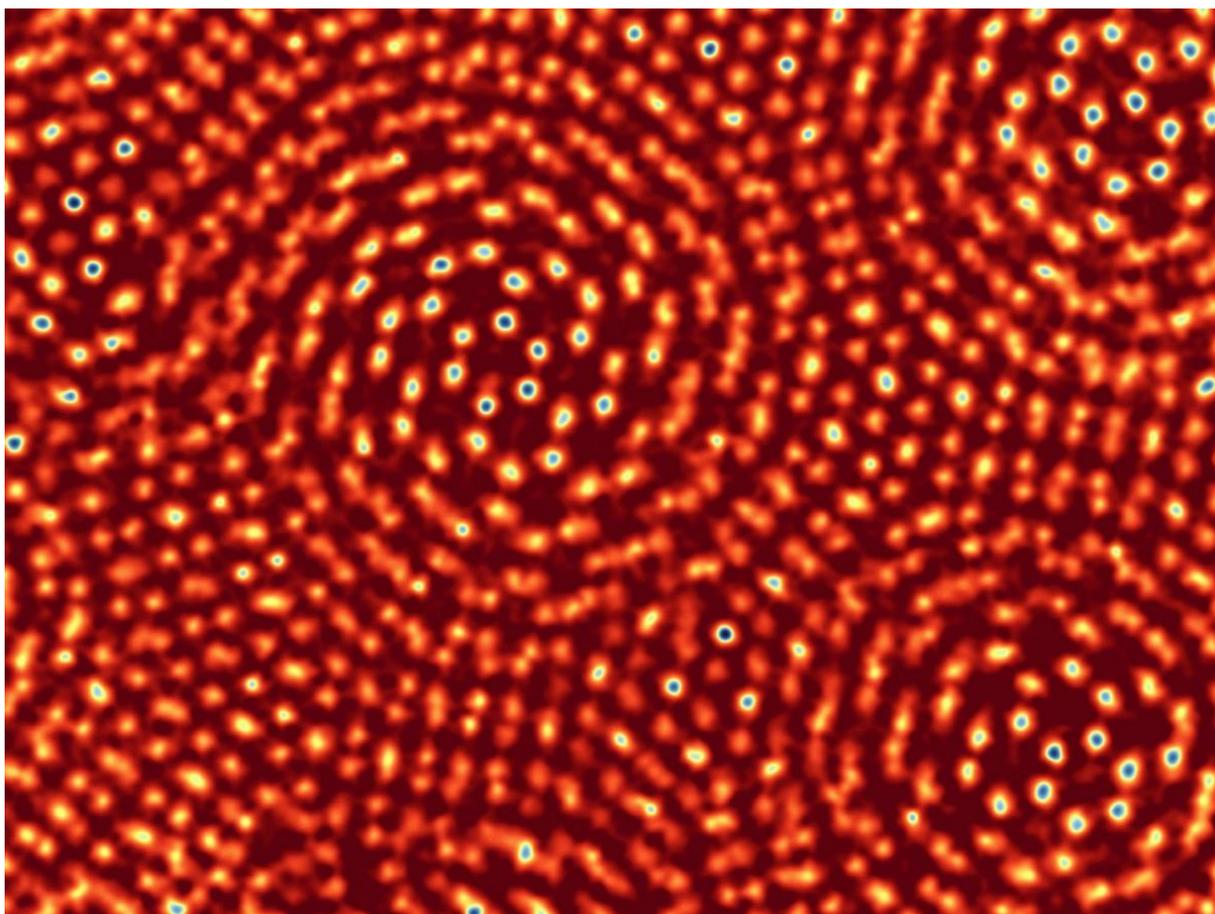


Fig. 1 A ptychographic image of two sheets of molybdenum disulfide, with one rotated by 6.8 degrees with respect to the other. The distances between individual atoms range from a full atomic bond length down to complete overlap. Image courtesy of Prof. David Muller.

[1] “Electron ptychography of 2D materials to deep sub-ångström resolution”, Jiang et. al, Nature, volume 559, pages343–349 (2018) <https://doi.org/10.1038/s41586-018-0298-5>

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Notes for the Editor

About Phasefocus

Phasefocus provides a range of products and services based on its proprietary Ptychographic Quantitative Phase Imaging (QPI) technology, pertinent to a wide range of analytical applications requiring reliable and robust image capture and data handling.

The Phasefocus technology permits capture of information rich phase data at multiple wavelengths enabling observation and analysis of materials, processes and products at nano scale level.

With broad spectrum appeal, this innovative technology has potential for use in diverse markets ranging from life science and healthcare to engineering, metrology and more.

Livecyte™, the company's flagship live cell imaging system is revolutionising the study of cell behaviour, allowing researchers to measure the morphology and motion of every cell over time.

Cells are imaged in a controlled environment at scale, (up to 96 well plate format) without the use of labels. Livecyte automatically identifies and tracks individual cells, even within a heterogeneous cell population, saving days of analysis time, compared to manual tracking. The result is more statistically valid data providing increased confidence in the interpretation of results.

Ptychographic imaging is accomplished using low laser power, 10,000-100,000 times less than that used for fluorescence microscopy, which means that cells can be imaged for long periods of time (eg greater than 1 week) without suffering photo-toxic effects. This is beneficial for all cell types but especially for sensitive cell types such as stem cells and primary cells.