New Approaches to Tilt-Corrected Bright-Field Scanning Transmission Electron Microscopy

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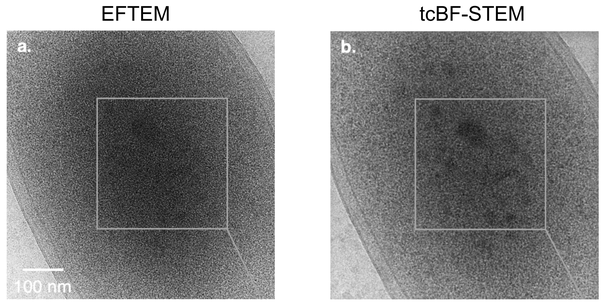
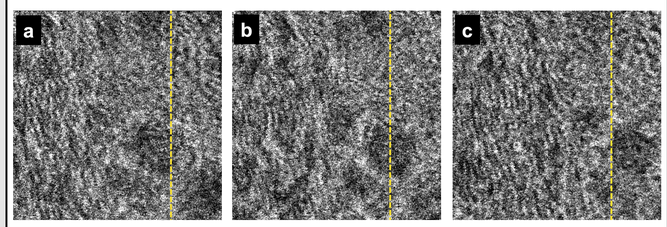
Background



- Structural biologists have begun exploring tilt-corrected bright-field STEM (tcBF-STEM) as a solution for imaging thick samples
- Pixelated detectors allow for tcBF-STEM, but image shifts must be corrected



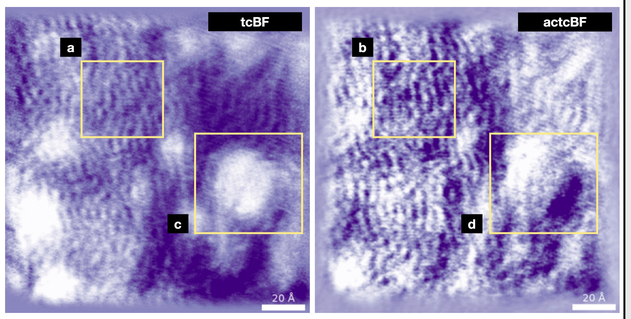
- tcBF-STEM does not correct for aberrations in images obtained from the tilt series. We set out to do this
- A comparison of tcBF-STEM and actcBF-STEM was conducted through experimentation and simulation

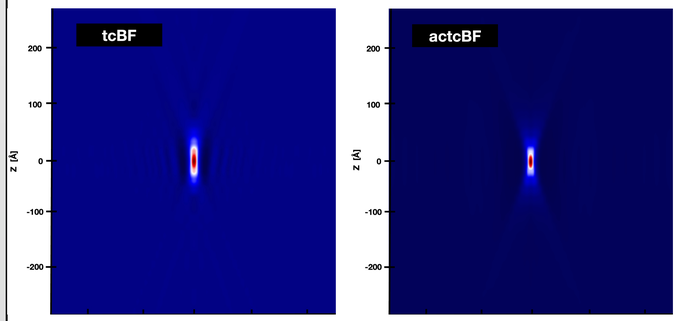
Methods

- 4D-STEM data was collected on platinum nanoparticles grown on carbon flakes using the Thermo Fisher Titan 300 S/TEM (60-300 kV) equipped with an electron microscopy pixel array detector (EMPAD)
- Depth resolution was compared through a qualitative examination of the cross section of a simulation of a single atom in empty space using both tcBF-STEM and actcBF-STEM

Results

- The figures to the right show the comparison of tcBF-STEM and actcBF-STEM image reconstructions
- Reconstructions are from the same 4D-STEM dataset
- The images show a comparison of the carbon flakes, (a) and (b), used to grow the platinum nanoparticles.
- Highlighted in (c) and (d) is the most visually discernable instance of a platinum nanoparticle.





- The images to the left show the result of a cross-sectional analysis of stack of images obtained from a depth section simulation of a single atom
- The cross-sectional slice was through the center of the x-axis
- There were 33 total images obtained from the depth section. The depths ranged from -240 Å to +240 Å defocus

Conclusions

- As shown in (b) and (d), actcBF-STEM displayed higher resolution than tcBF-STEM, leading to sharper vertical lines of carbon flakes and clear platinum nanoparticles
- In simulation, actcBF-STEM showed more accurate depth resolution than tcBF-STEM, diminishing any undesired oscillations
- Further work is needed for a detailed experimental comparison of depth resolution

Acknowledgements

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References

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