Comparison of horizontally and vertically positioned cameras for TKD

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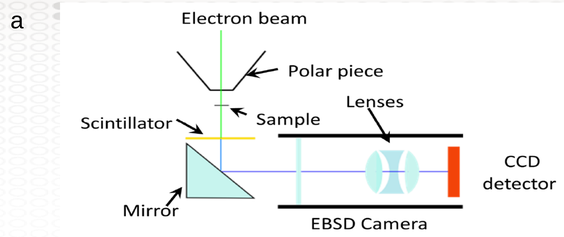

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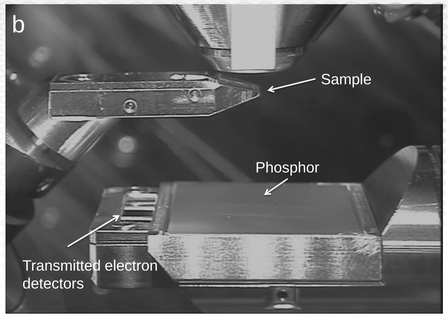
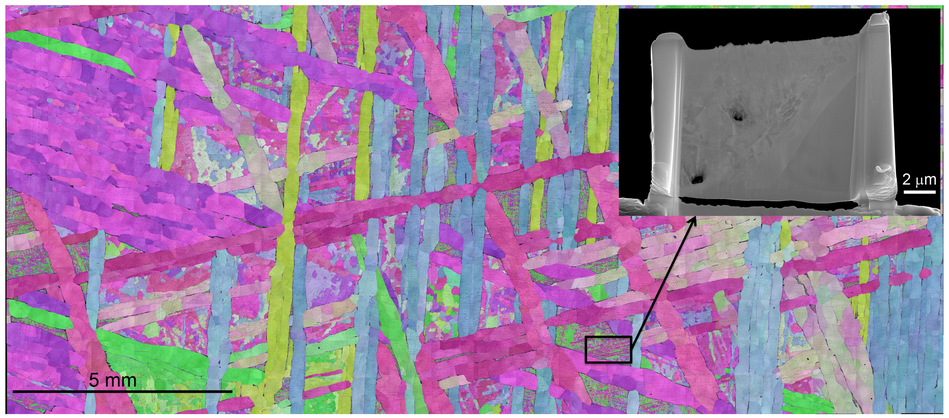


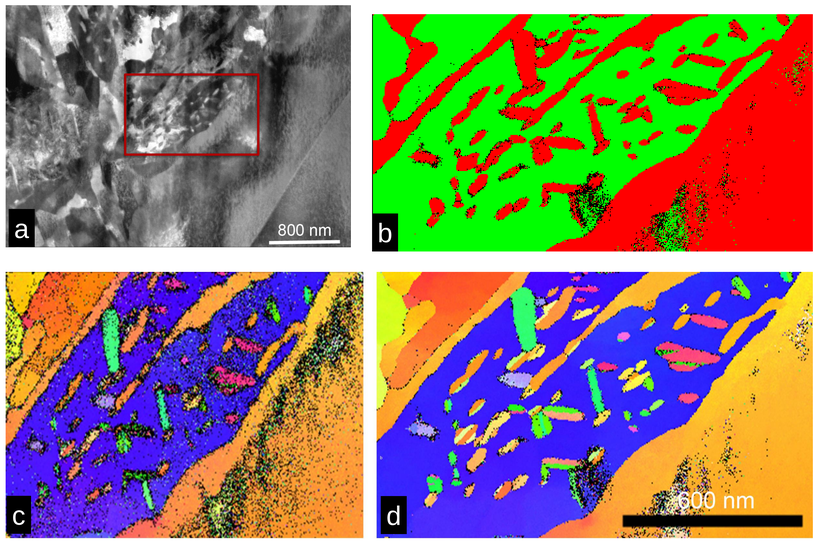
Horizontal on-axis detector for TKD a) schematic, b) Chamber image of the detector and sample arrangement in a Zeiss Supra 55VP SEM.

TKD has been successfully carried out on standard EBSD cameras. This geometry results in extreme pattern distortions due to the gnomonic projection. A horizontal on-axis camera arrangement (Bruker, Optimus) has been tested that removes the pattern distortion and allows lower beam currents to be used.

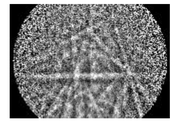
This study compared the standard vertical and the new horizontal phosphor screen arrangements. Thin samples were produced using an FEI Helios FIB/SEM and the samples were finished using 2 kV milling. The Gibeon sample was produced in-situ while the polycrystalline Si samples were mounted on thin carbon films and then for TKD the sample was oriented so that the carbon film faced the electron beam. The samples were plasma cleaned between analyses to ensure that contamination did not interfere with pattern quality.



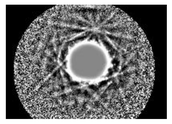
Large area orientation map of Gibeon iron meteorite prepared by standard metallographic techniques. Plessite is the fine grained areas that contain both austenite and ferrite. Inset image is of the FIB prepared thin sample milled from a region of Plessite.



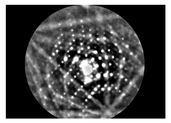
Images acquired at 30 kv from a thin sample of Plessite from the Gibeon meteorite. a) STEM image of the thin sample using the three on–axis detector diodes. No data cleaning has been applied to the orientation maps. b) Phase map of the sample region with austenite (red) and ferrite (green) regions. c) TKD IPF maps acquired with the standard vertical detector orientation. The data was acquired at 30 kV with a 120 μm final aperture in high current mode (5nA) on a Zeiss Supra 55VP. Exposure time of 7 ms/pattern and a step size of 3.8 nm were used resulting in a 80.1% indexing rate. d) TKD IPF maps acquired with the horizontal on-axis detector orientation. The data was acquired at 30 kV with a 60 μm final aperture in high current mode (1 nA) on a Zeiss Supra 55VP. Exposure time of 7.6 ms/pattern and a step size of 3.1 nm were used resulting in a 97.6% indexing rate.



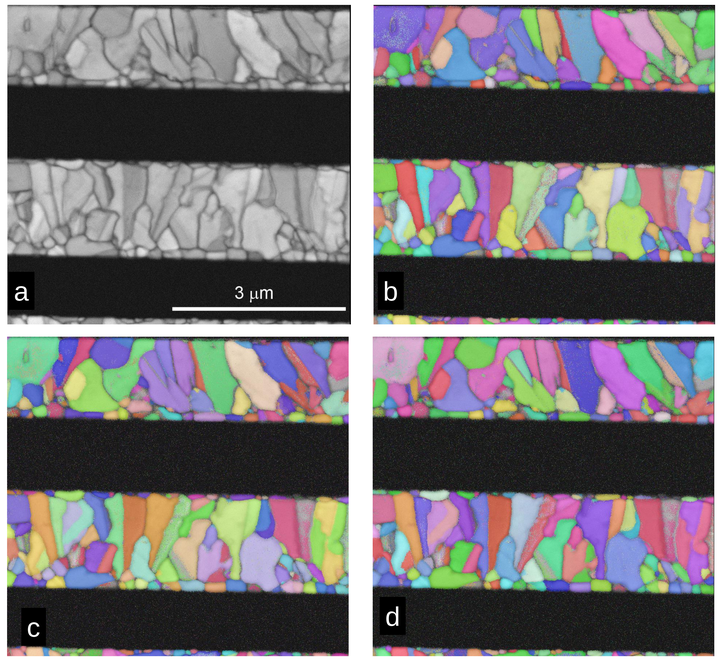
FCC pattern acquired with vertical phosphor.



FCC pattern acquired with horizontal on-axis phosphor.



FCC pattern acquired from a very thin region of the sample with the horizontal on-axis phosphor.



TKD of polycrystalline Si for microelectronic applications. Images were acquired at 30 kV with a 60 μm final aperture in the high current mode using the on-axis horizontal phosphor screen. Exposure time of 10.5 ms/pattern and a step size of 6 nm were used. No data cleaning has been applied to the orientation maps. a) Band contrast image b) IPF X with band contrast c) IPF Y with band contrast d) IPF Z with band contrast.

Initial Observations:

- **Indexing rate and generally indexing speed is increased with the on-axis phosphor screen when compared to the standard vertical phosphor screen.**
- **Lower beam currents can be used with the on-axis horizontal phosphor screen due to geometrical effects as compared to the vertical phosphor screen arrangement.**
- **Samples that are too thin (depends on composition) begin to yield spot patterns rather than Kikuchi bands. This may make indexing more difficult.**
- **Electron beam parameters are more important with on-axis phosphor screen. Some influence of the beam convergence angle on the pattern quality has been noted and is currently being evaluated.**
- **On-axis detector diodes produce higher quality STEM images than the off-axis diodes on standard geometry detectors.**

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