EBSD system installation and commissioning

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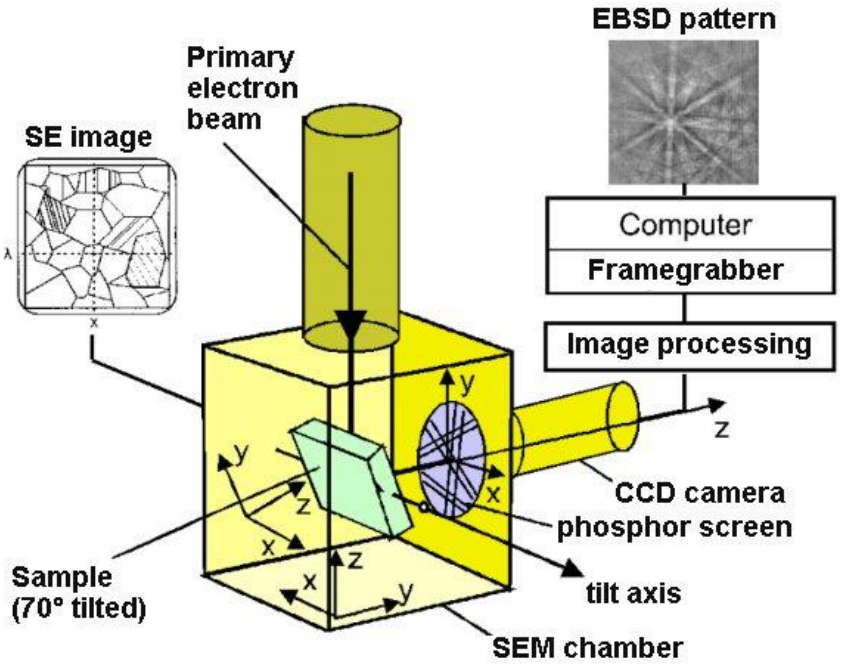
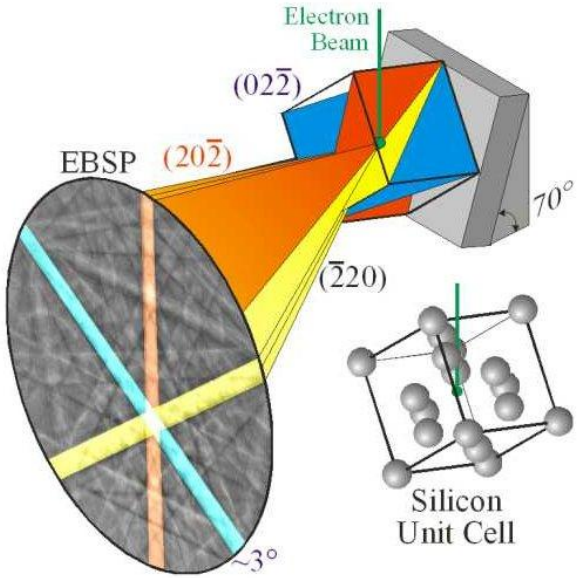
EBSD overview

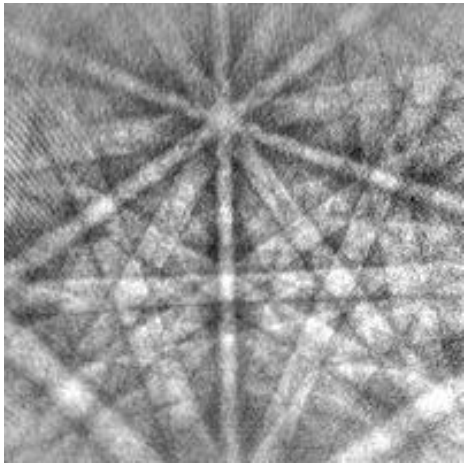
- Oxford Instrument Nordlys II S detector with HKL Channel 5 full data analysis software – attachment to existing Jeol LV 5900 SEM
- Upgrade to EDS detector to EDS Inca 200
- Applications
  - Crystalline orientation mapping
  - Dislocation density distribution
  - Strain mapping
  - Etc etc – a few tens of data analysis methods for different purposes

Principle of operation





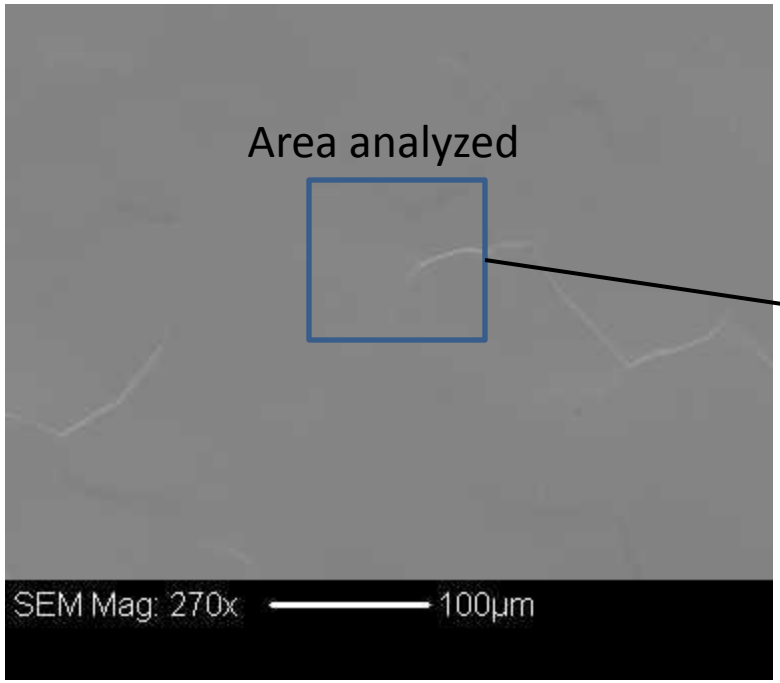
Kikuchi pattern



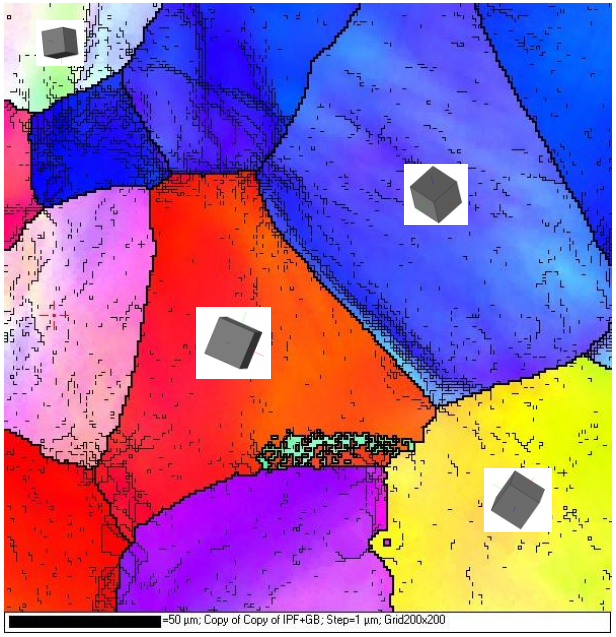
- Based on diffraction of electrons from crystalline lattice planes
- Kikuchi patterns allow indexing the orientation of crystal unit cell at the spot irradiated with electron beam
- Spatial resolution for mapping – limited by SEM, probably ~0.5 um in our case due to noise
- Information depth - 50-100 nm for Nb

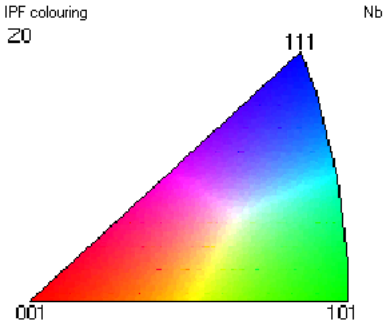
Crystalline orientation mapping

SEM image



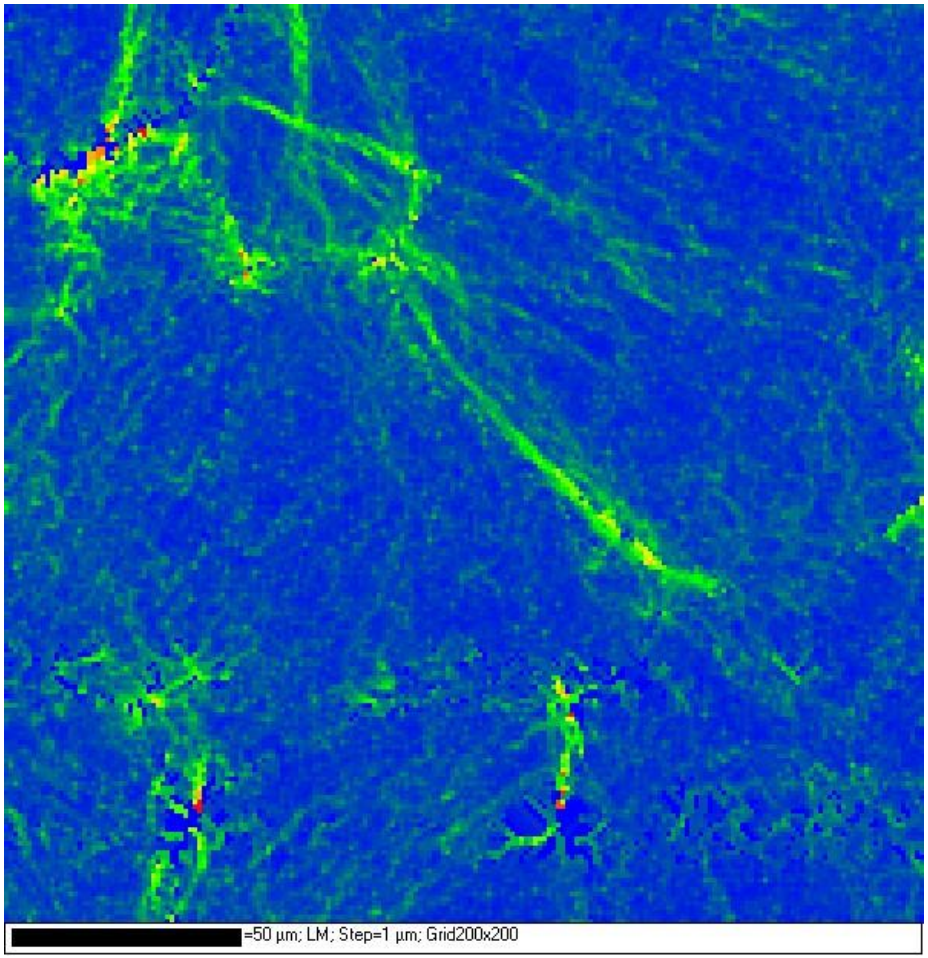
Grain boundaries shown for high (>10 deg) and low (>1 deg) angles





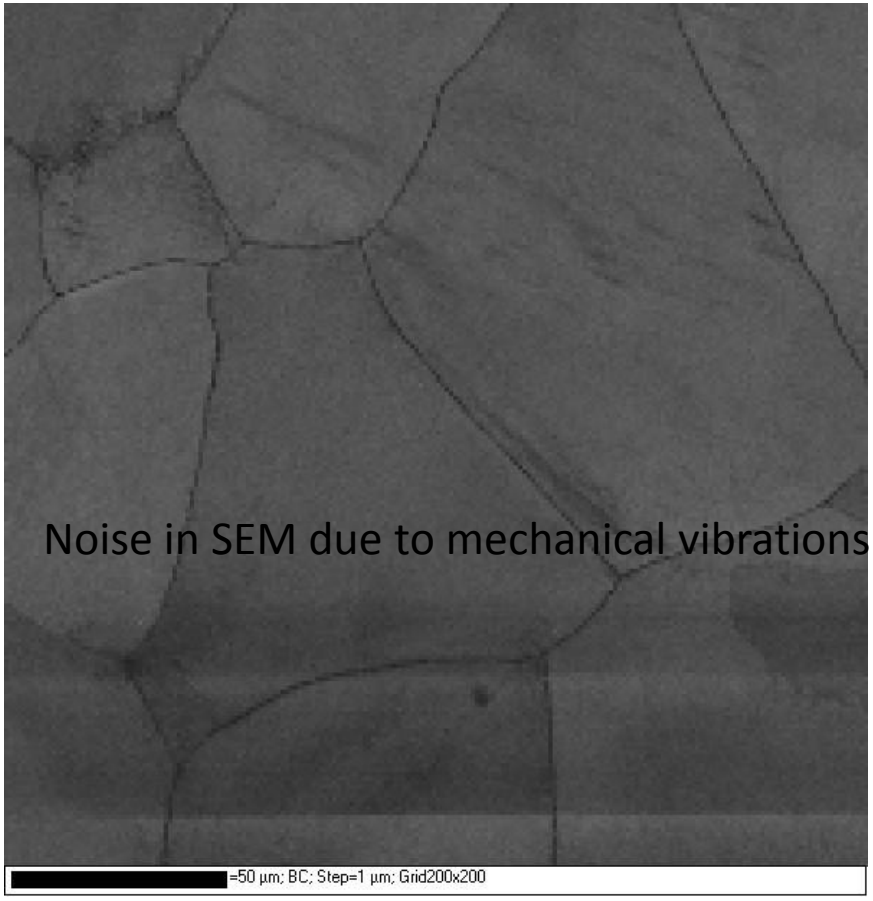
- Used an EP cavity cutout – real (not ideal) sample with curvature etc
- Obtained 83% indexing with mean angular deviation of 0.54 – high quality data

Local misorientation

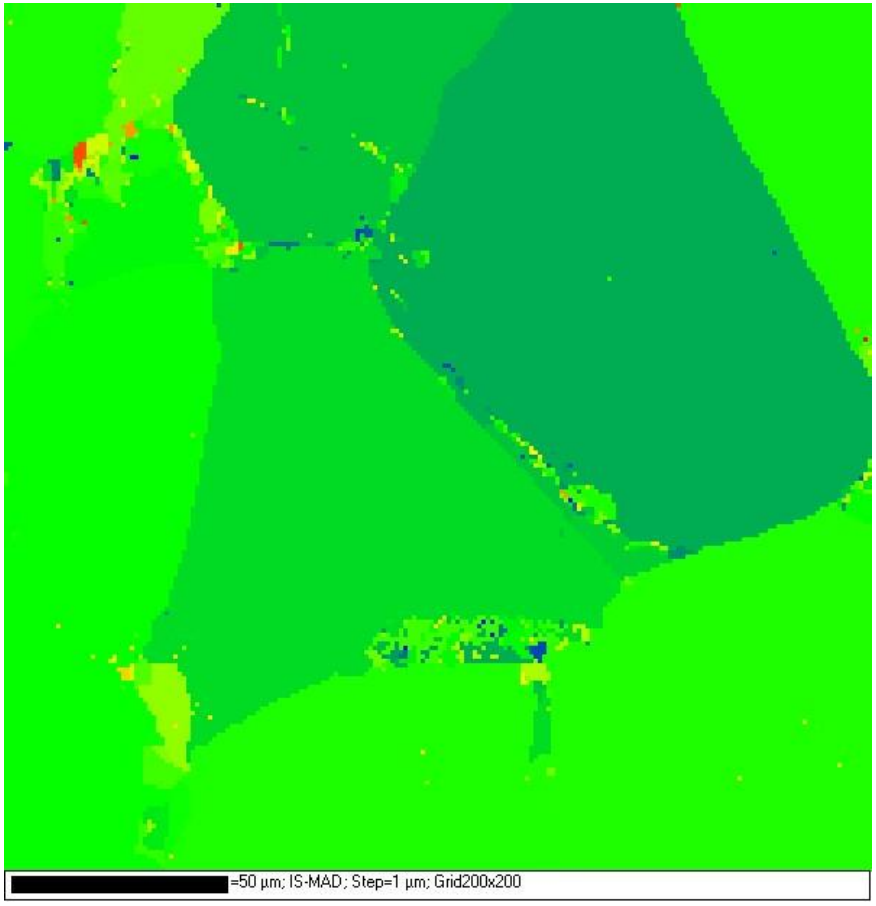


- Characterization of how distorted crystalline lattice locally is
- Directly connected to dislocation density
- Additional software developed at Cornell earlier allows detailed analysis of dislocation densities

Band contrast and mean angular deviation statistics



Kikuchi band contrast



Mean angular deviation (fit quality)

Summary and issues

- State of the art EBSD system is fully operational
  - Basic operational training completed (D. Hicks, D. Burk)
- Additional SEM accessories ordered
  - Stubs for sample holder, silver paint, sample storage boxes
- SEM noise (mostly mechanical vibrations) limits the data quality
  - Before moving to another room insulation from mechanical vibrations should be minimized
- Coupled EBSD/EDS not possible due to chamber geometry
  - Minor issue – never used in practice