

IMAGING MICROSTRUCTURE WITH HIGH-ENERGY X-RAYS

- Direct-beam based
 - Volume based on beam size, typically 0.1-10 mm³
 - Linear resolution \sim (beam size) / 1000
 - Absorption or phase contrast w/synchrotrons
 - Rotation series \rightarrow reconstruct
 - 3D volume of morphological features (cracks, 2nd phases etc)
- Diffraction-based, grain resolved (3DXRD or HEDM)
 - Make xray volume (just) small enough to resolve distinct reflections (synch $< \sim 10k$ grains)
 - Rotation series \rightarrow reconstruct
 - 3D grain-resolved: size, position, orientation, strain
 - As detector is moved further away, more sensitive to strain than position (nf-, ff-, vff- modes)
- Scattering-based, grain averaged (SAXS and WAXS)
 - Crystalline ('powder') & non-crystalline materials
 - Strain and volume for each phase present
 - Translate (& rotate) to image in 1D \rightarrow 2D \rightarrow 3D (scattering tomography)
 - Angle and energy dispersive modes

