

Bragg Coherent Diffraction Imaging of Local Strains in Polycrystalline Materials

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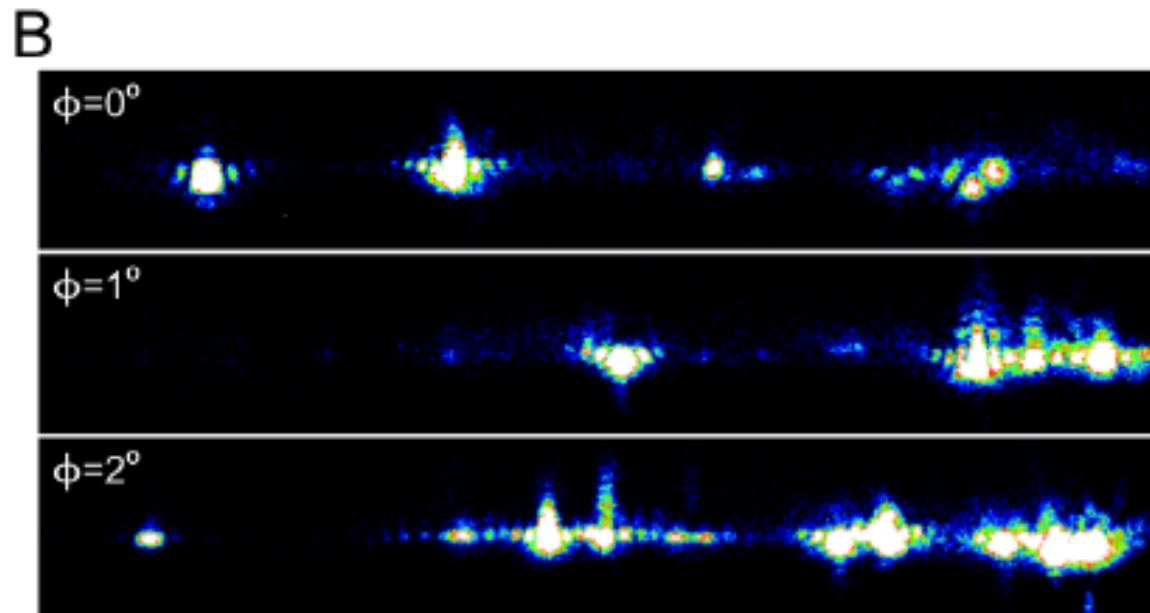
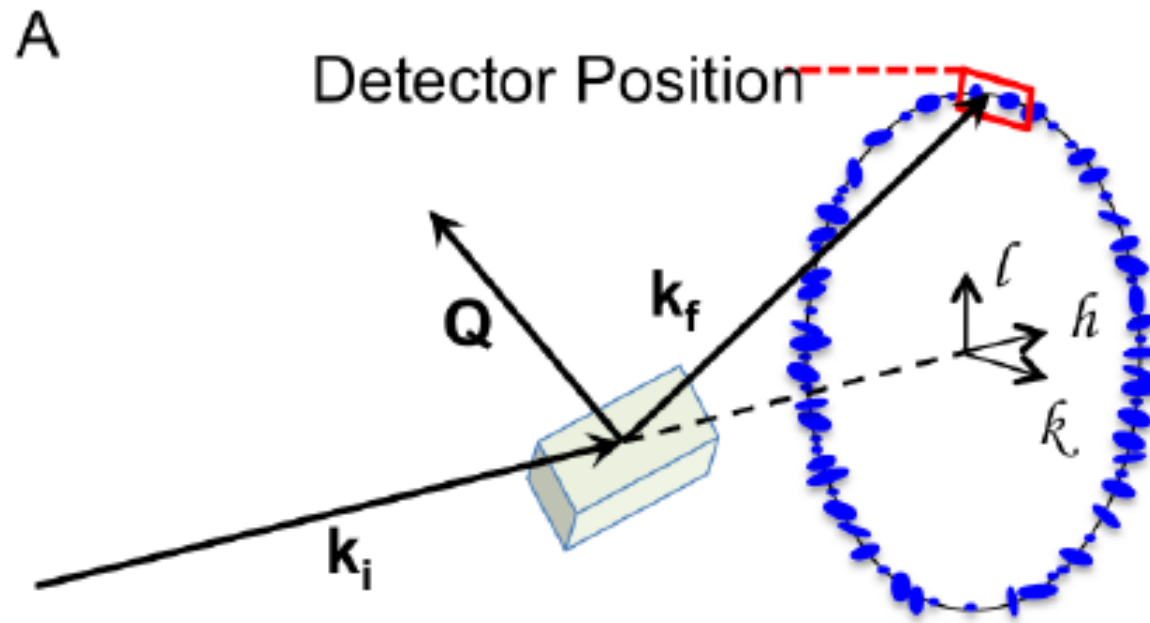
Workshop on Energy Research and
Technology,

Idaho National Laboratory

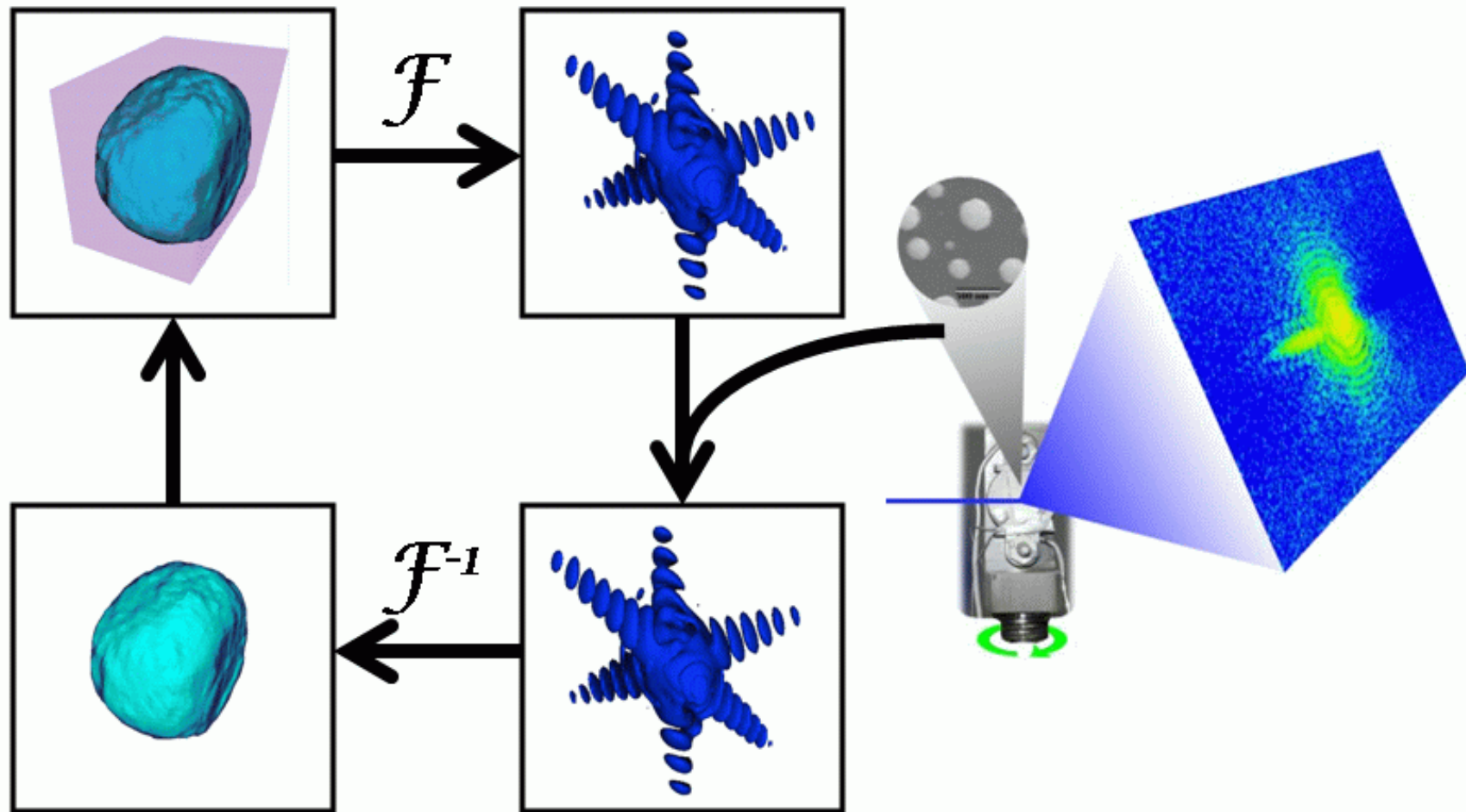
October 2020

Outline

- Bragg Coherent Diffraction Imaging
- Evolution of nanoparticle strain
- Application to Nuclear Materials



Generic “Error Reduction” method



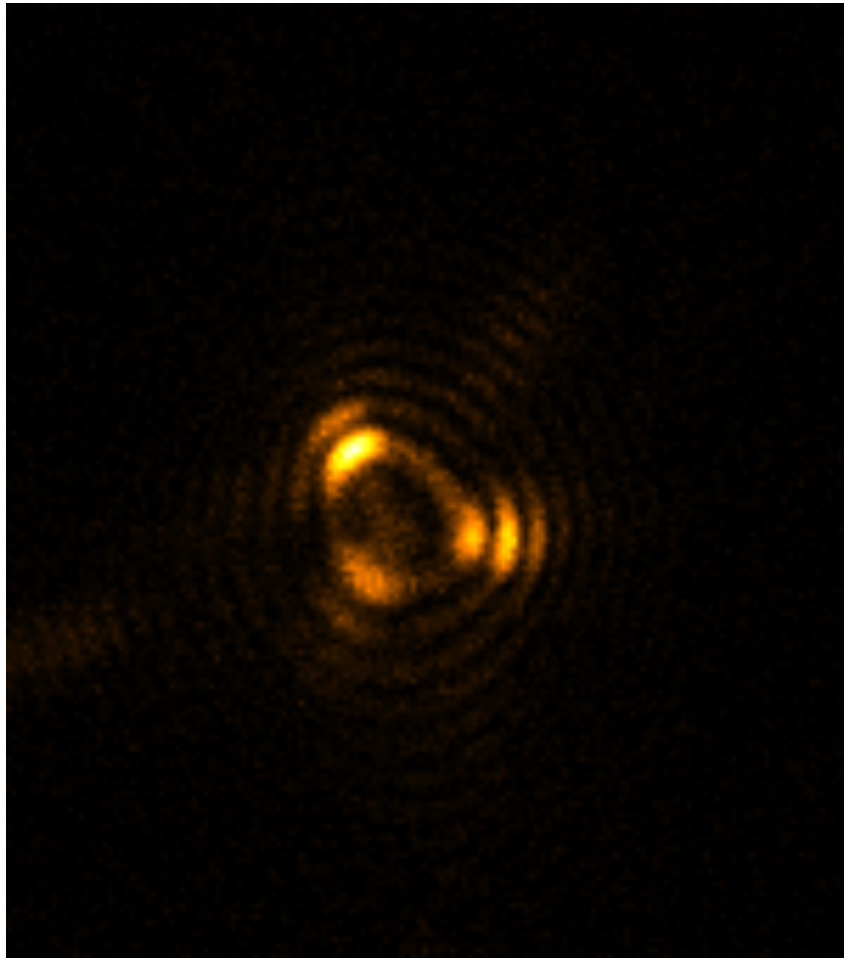
J. R. Fienup *Appl. Opt.* 21 2758 (1982)

R. W. Gerchberg and W. O. Saxton *Optik* 35 237 (1972)

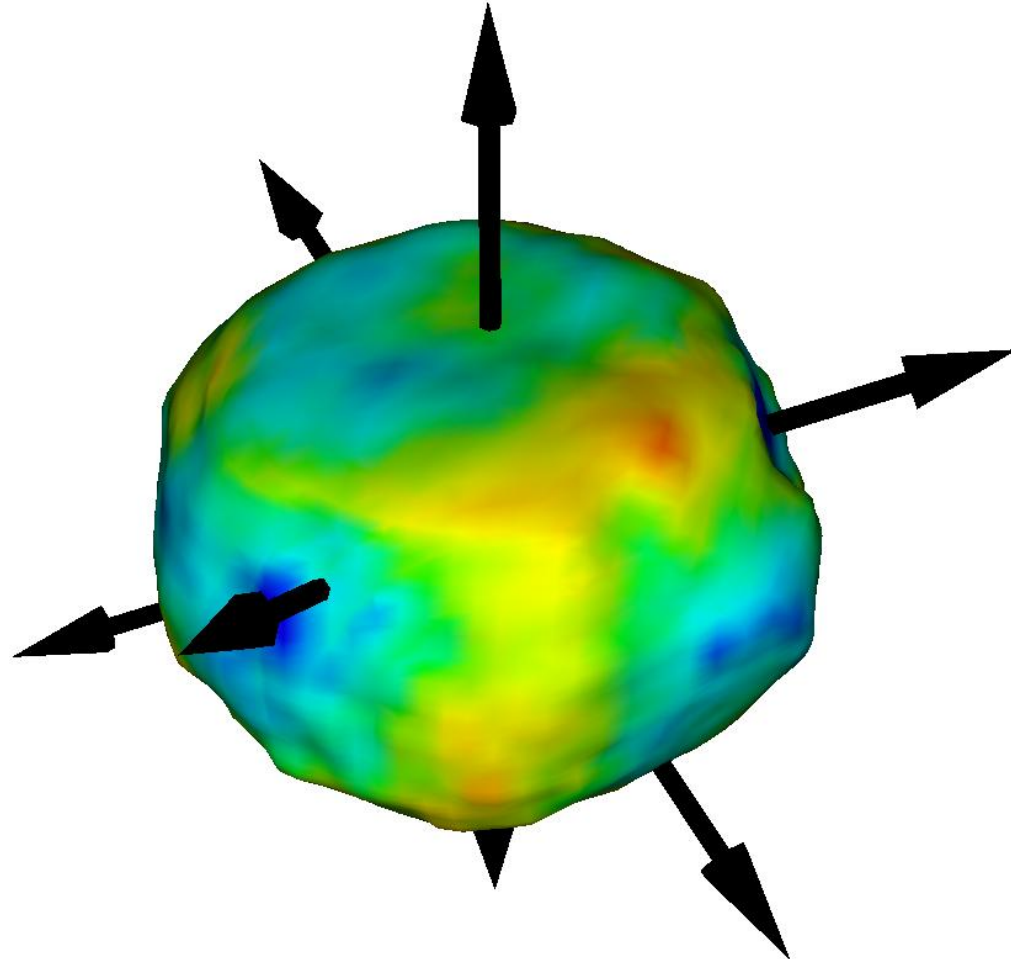
I. K. Robinson, Idaho Nat Lab 2020

Gold nanocrystal reconstruction

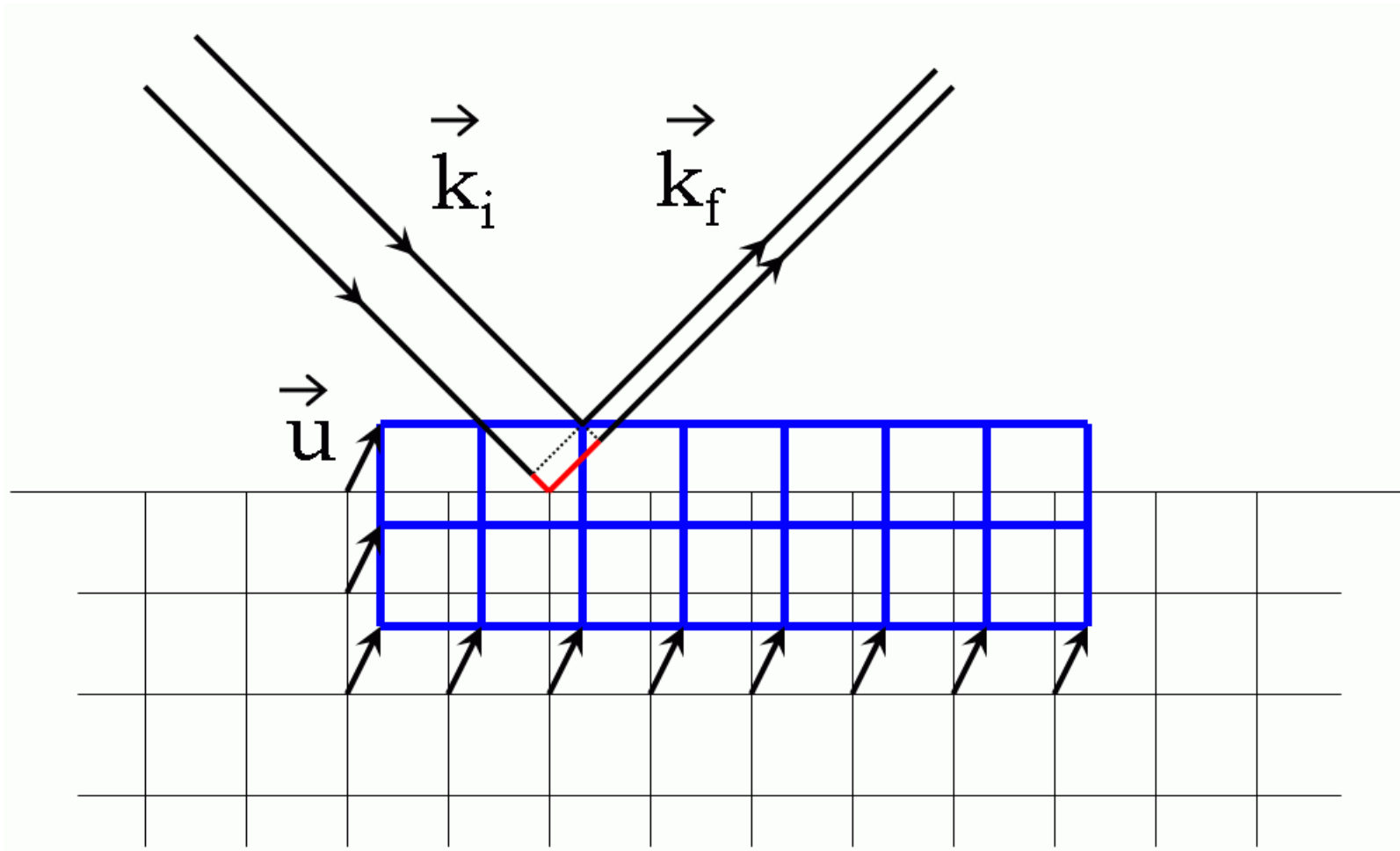
showing support used for 20 HIO followed by 10 ER



Phase isosurface of residual strain

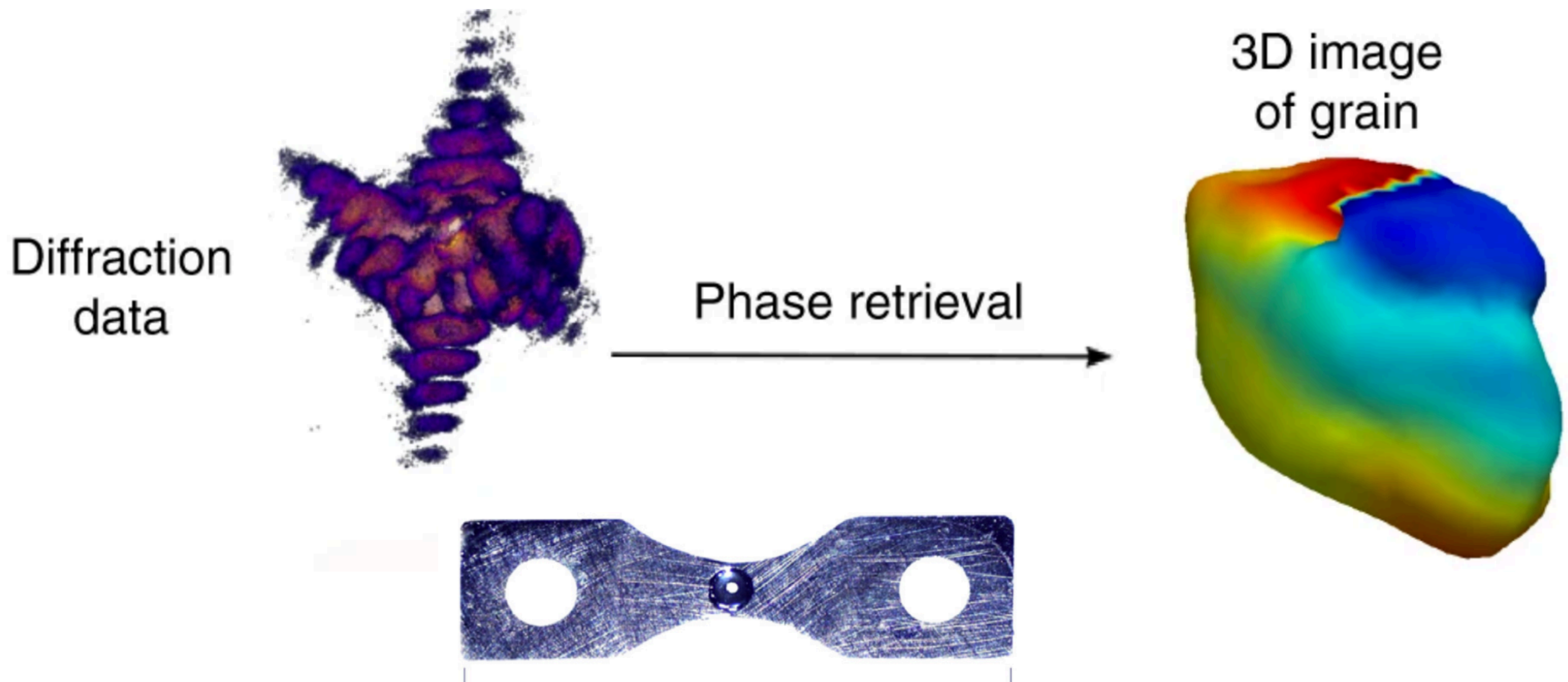


Sensitivity to strain

$$\Delta\varphi = \mathbf{k}_f \cdot \mathbf{u} - \mathbf{k}_i \cdot \mathbf{u} = \mathbf{Q} \cdot \mathbf{u}$$


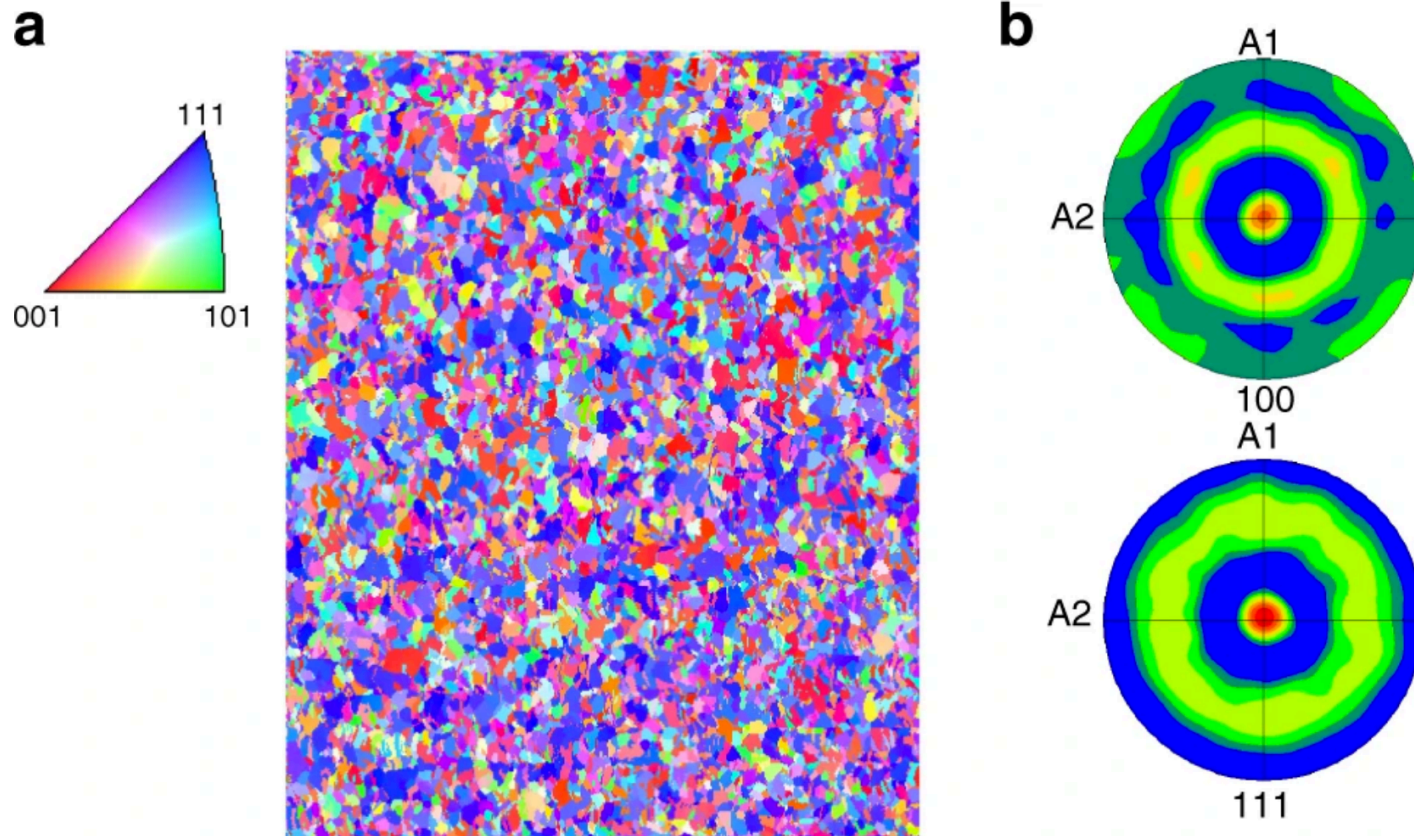
M. Cherukara and R. Sandberg

Nature Comms 9 3776 (2018)



M. Cherukara and R. Sandberg

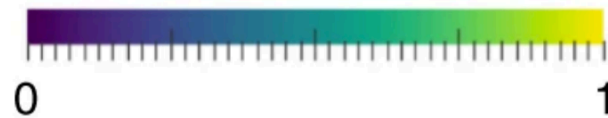
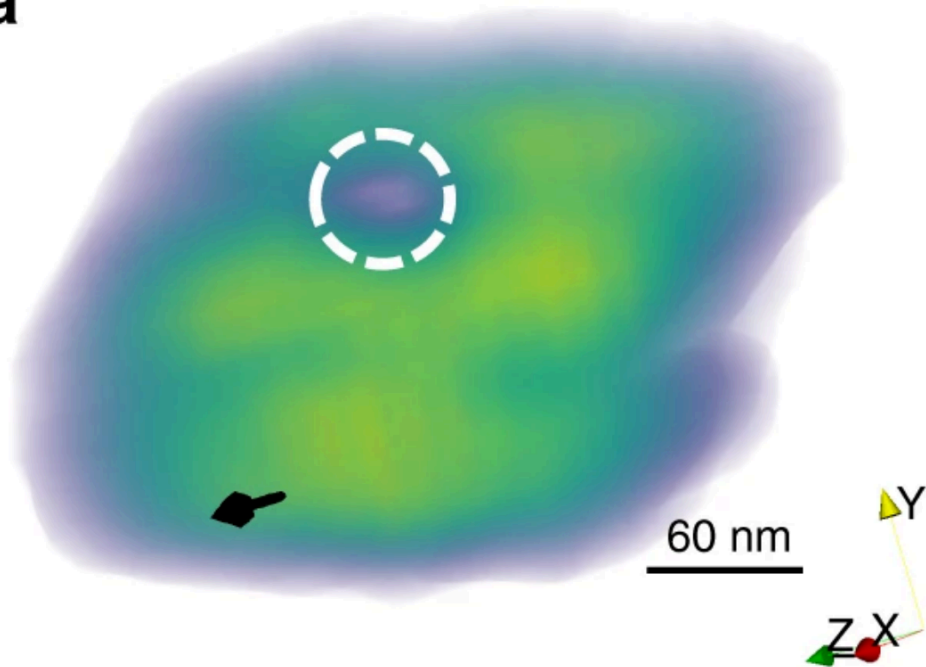
Nature Comms 9 3776 (2018)



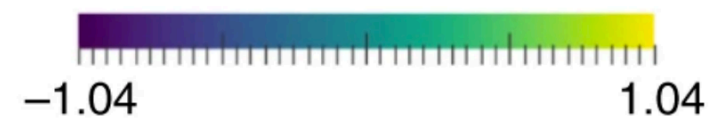
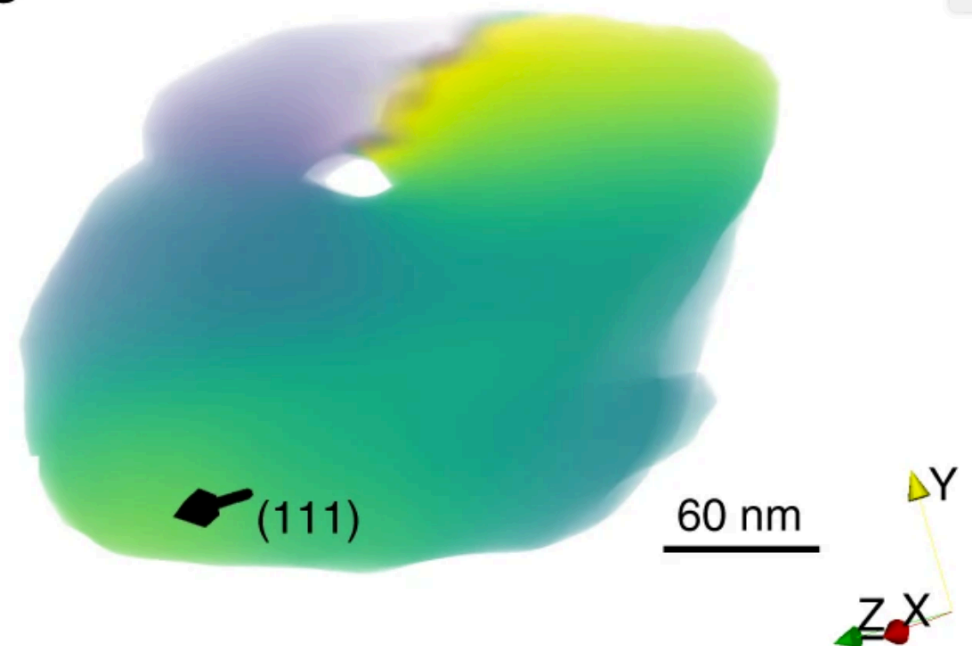
M. Cherukara and R. Sandberg

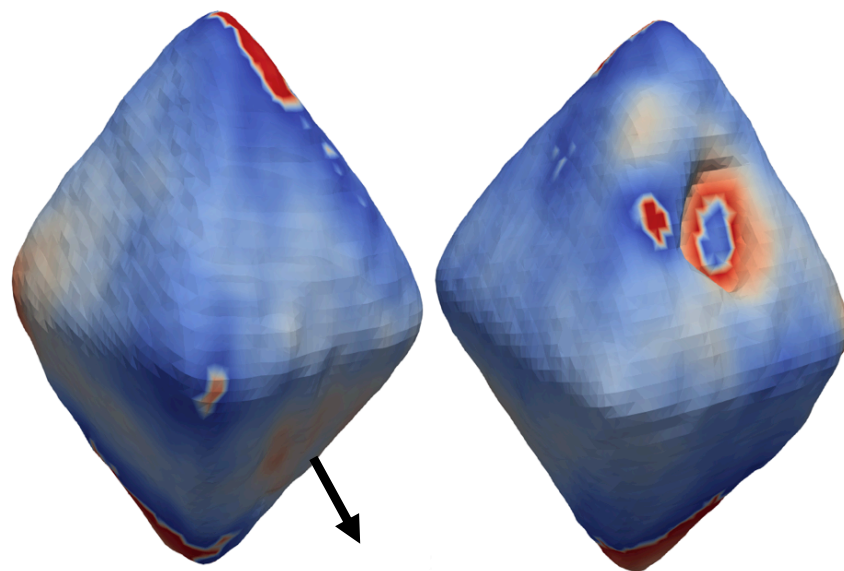
Nature Comms 9 3776 (2018)

a

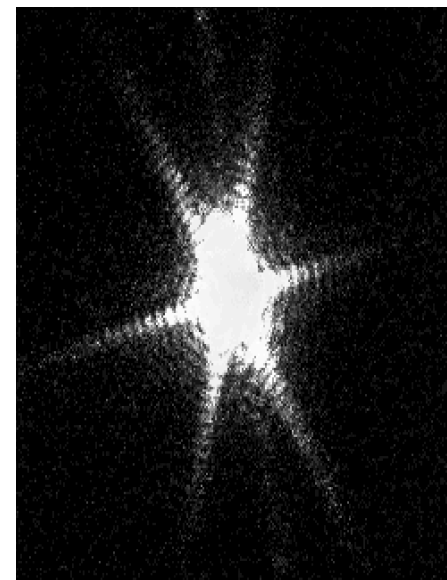


c



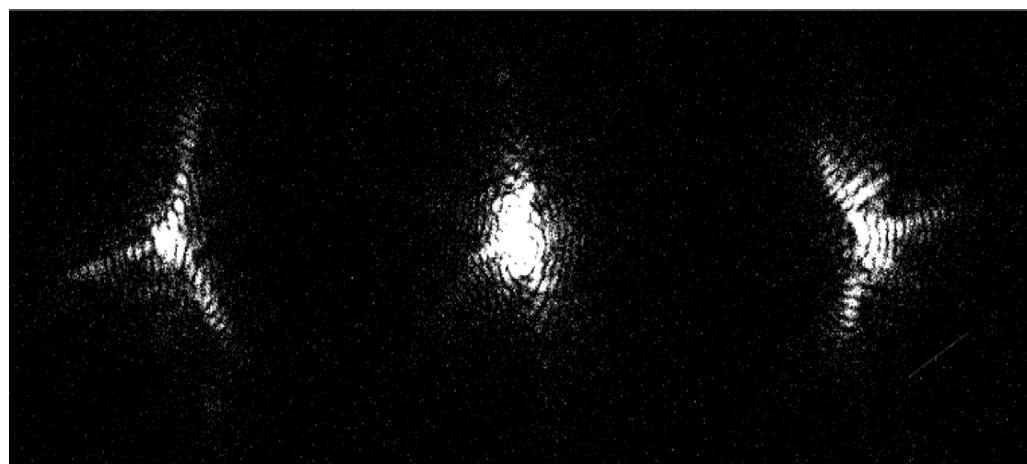


100 nm



3D Bragg peak

APS Oct 2019
Scan 585
Pd pristine state



20

30

40

Imaging of Nanocrystals under Strain

I. Robinson & R. Harder, Nat Materials 8 291-298 (2009)

- Bragg Coherent Diffraction Imaging (BCDI)
- High Sensitivity to Distortions
- Components of Strain Tensor
- Reports structure of buried grain
- Track evolution during processing