

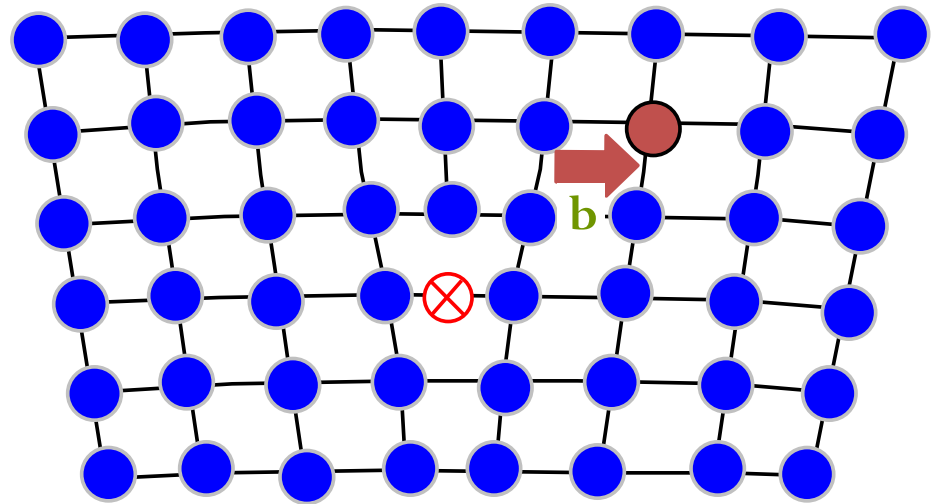
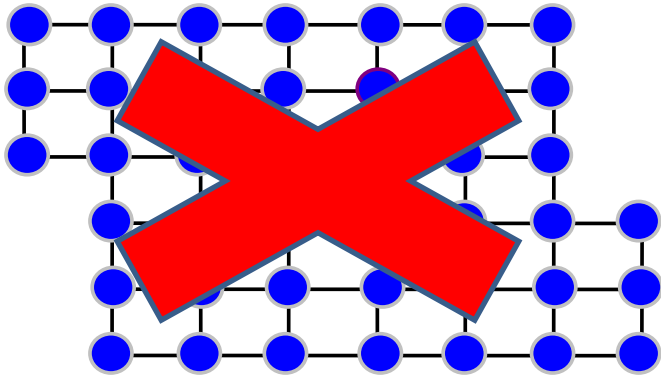
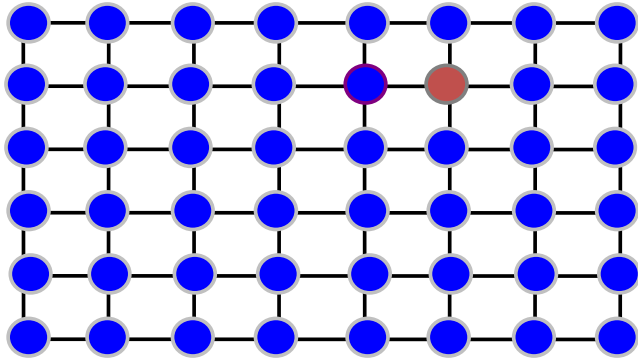
Line Dislocation Dynamics

Zachary Aitken

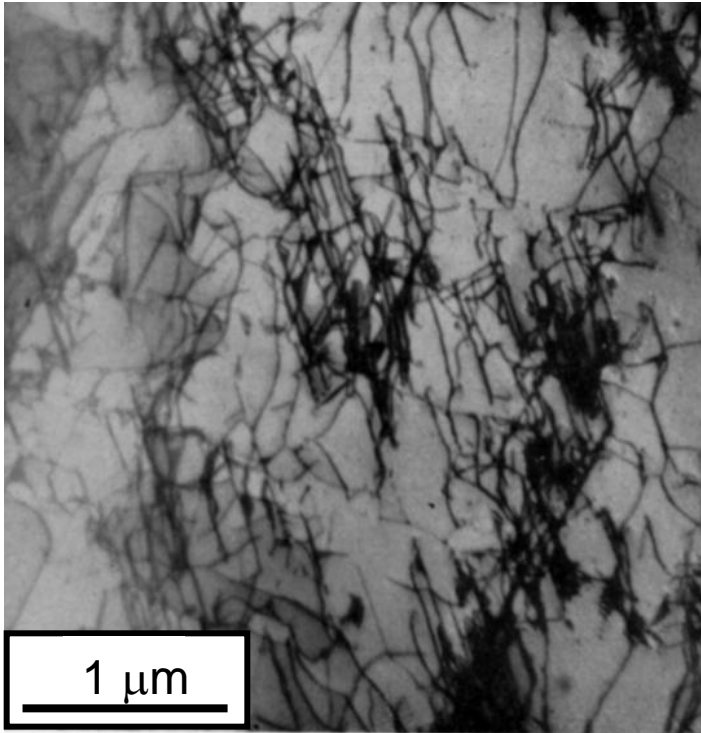
ACM114

Spring 2012

Crystalline Plasticity



**Dislocation
Line Defect**

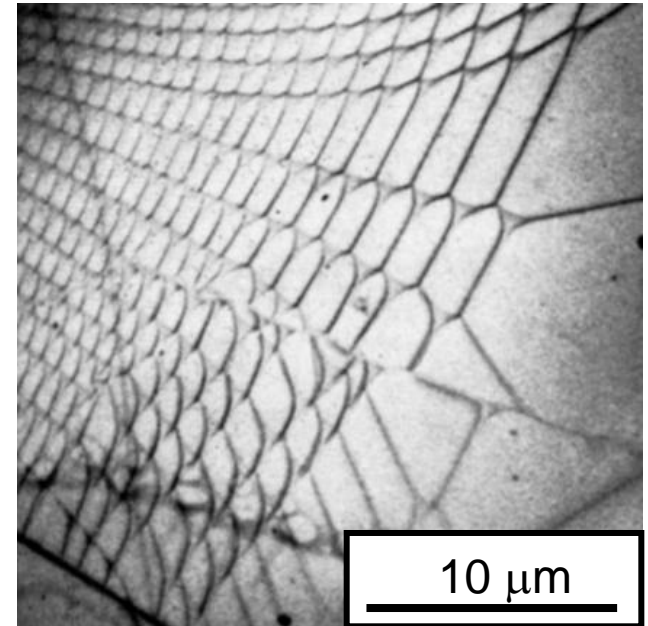


Dislocation tangles in strained stainless steel.

(Whelan, 1958)

Dislocation network in graphite

(Amelinckx 1960)



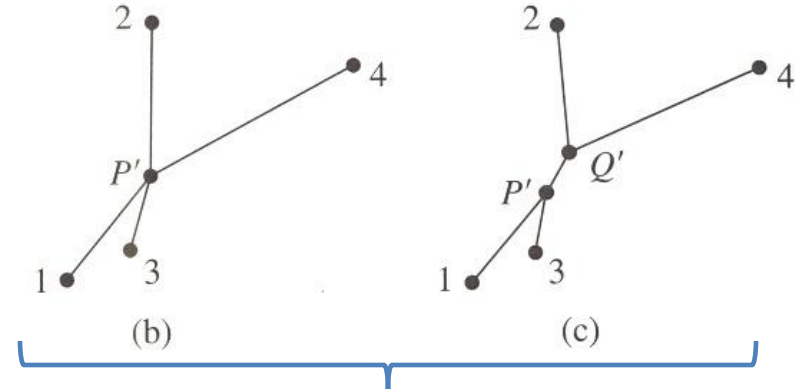
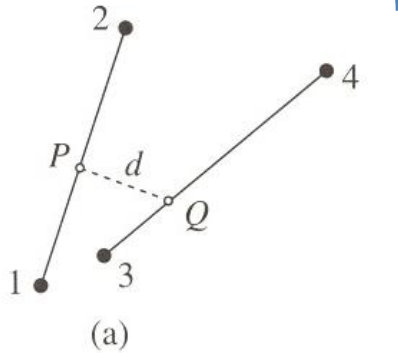
Plastic deformation is described by motion of dislocation networks

Line Dislocation Dynamics

Discretize by line segments

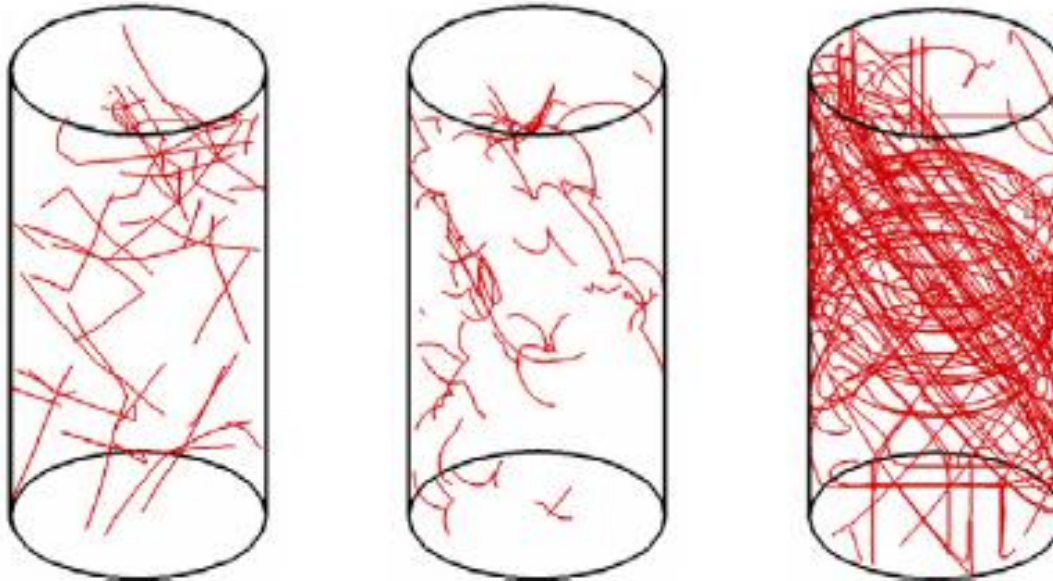
Continuum Elasticity
Interactions

$$v = Mf$$

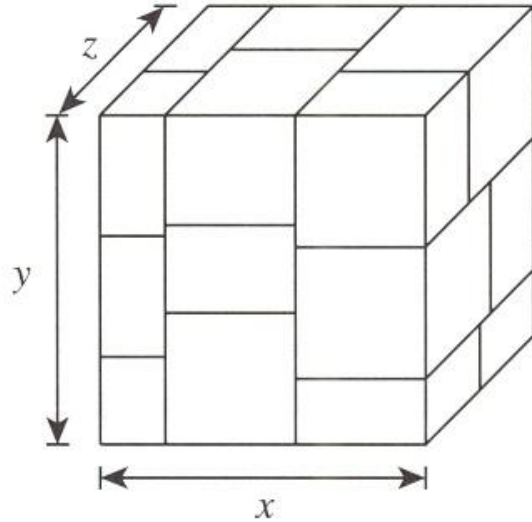


Diagrams by Wei Cai

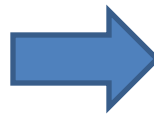
Topological changes



Parallelization and Meshing



Spatially Heterogeneous Structure



Physically Representative Volume:

- Long range interactions
- $\sim 10^6$ line segments

Local Segment multiplication



Nodal Redistribution
Criterion