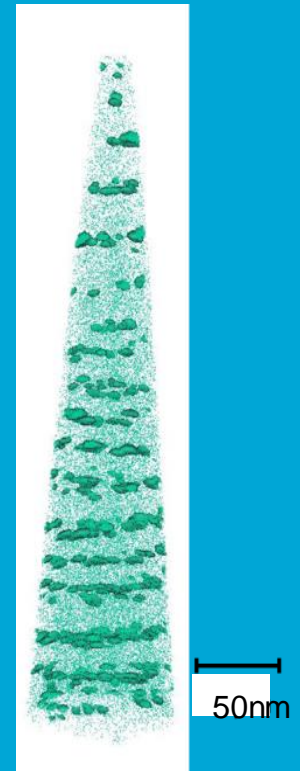
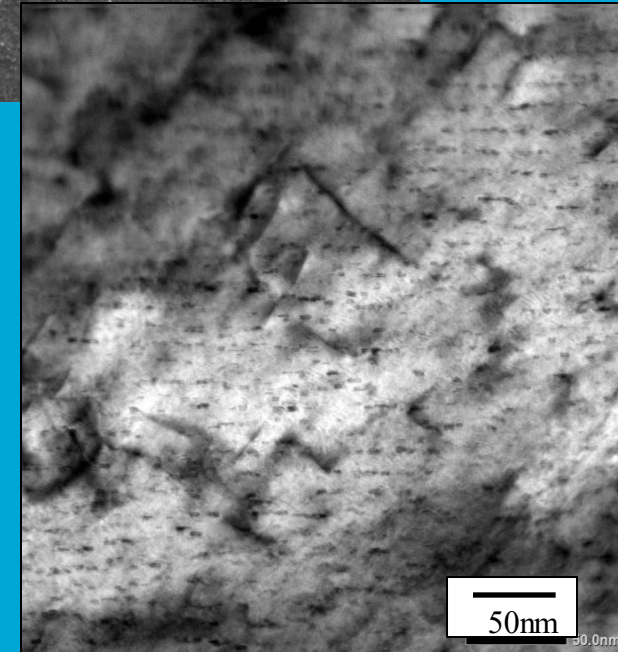
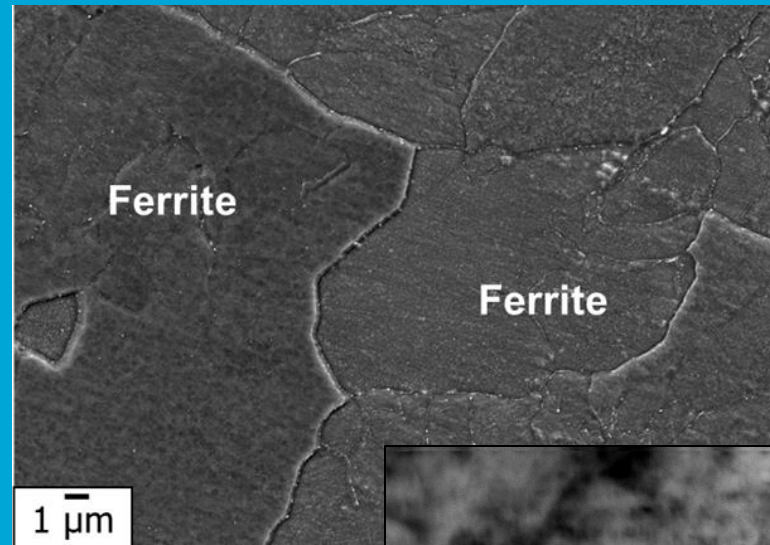


Similarities and differences between **microstructure** evolution during thermo-mechanical processing and during irradiation of steels

S. Erik Offerman



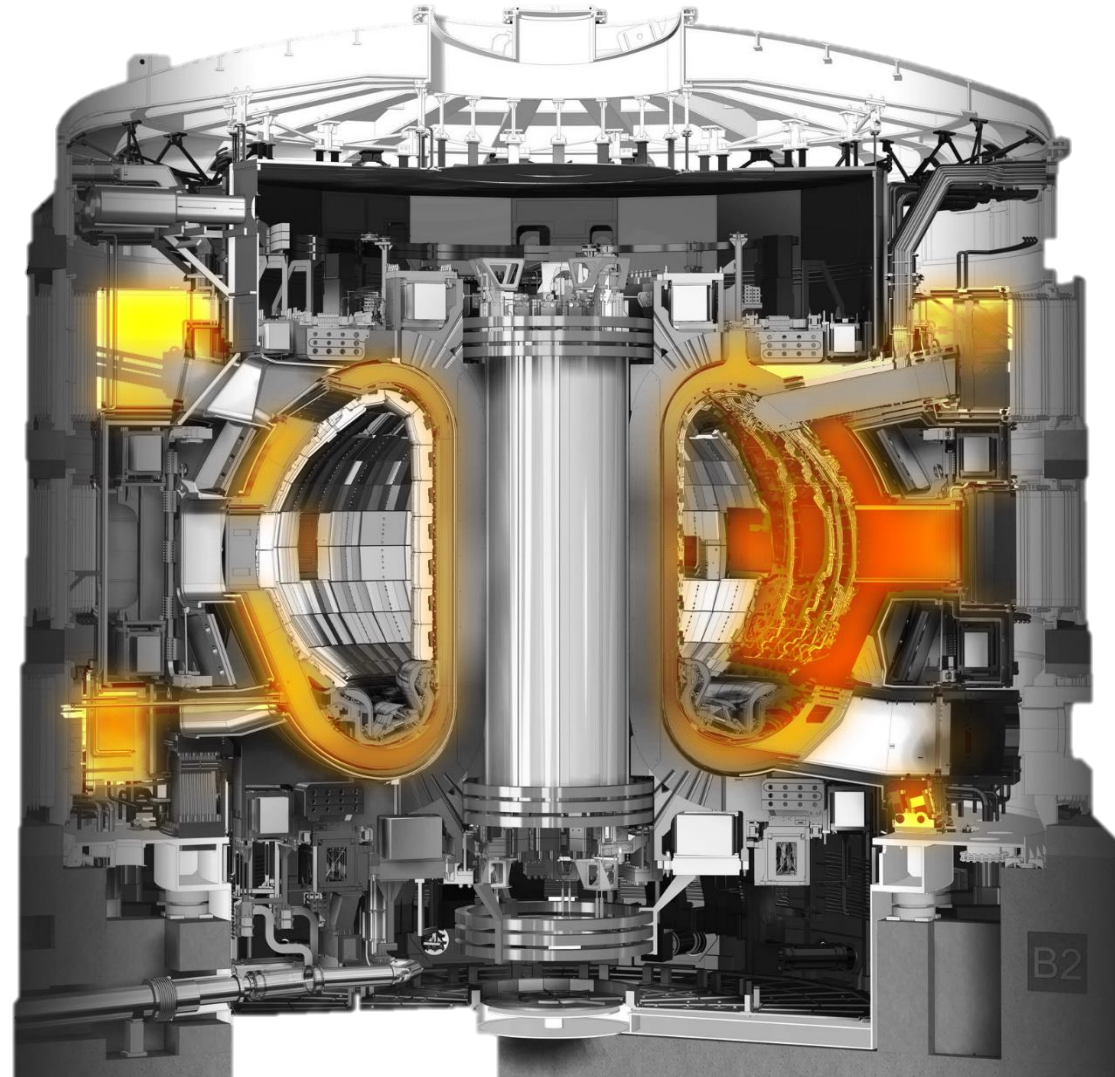
Background

- Steels
- Solid-state phase transformation kinetics
- Precipitation kinetics
- Recrystallization kinetics

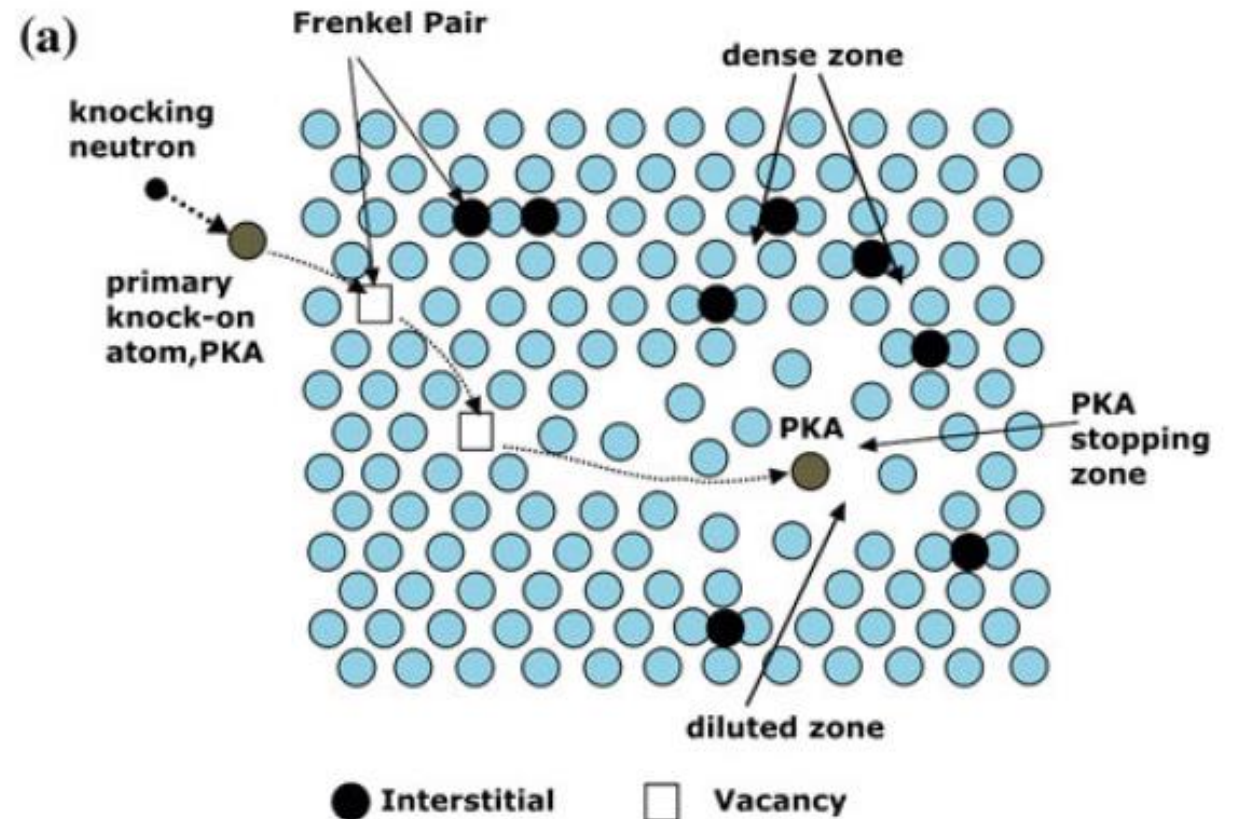


Relevance of steel for nuclear fusion & vice versa

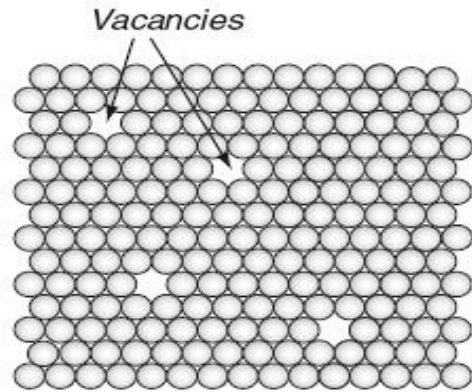
- ITER
- Vacuum vessel of steel
- Steel transition requires clean energy



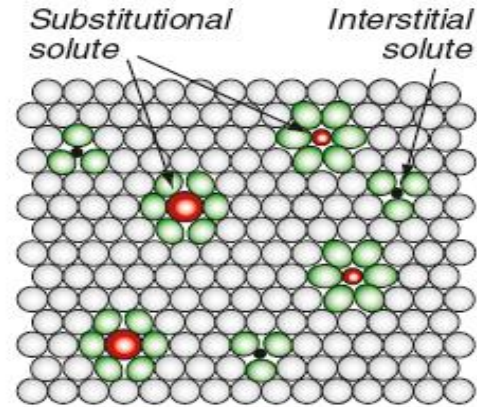
Defect formation during thermo-mechanical processing & during neutron irradiation



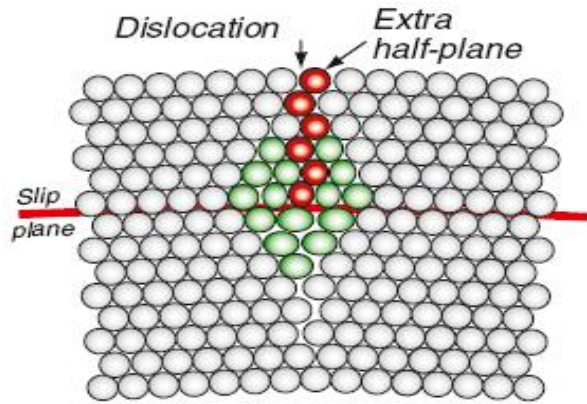
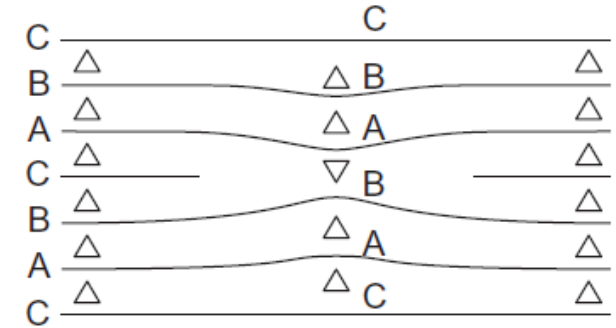
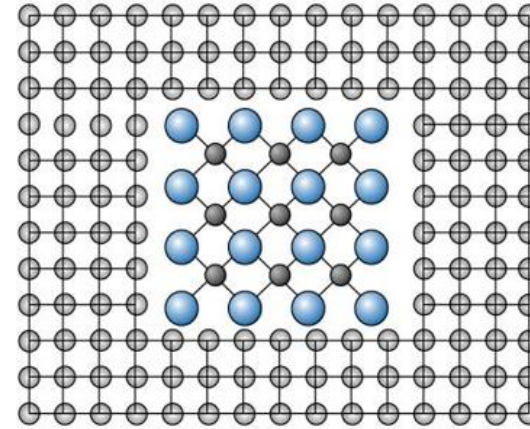
Common defects in metals



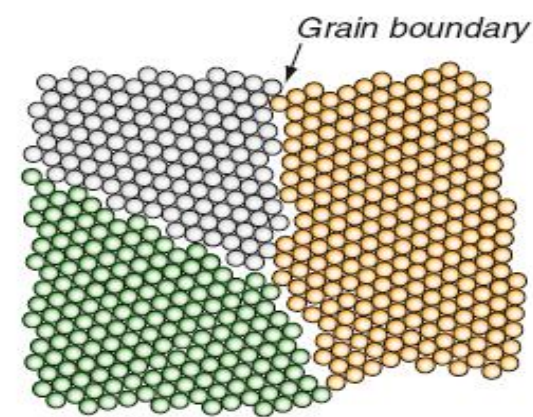
(a)



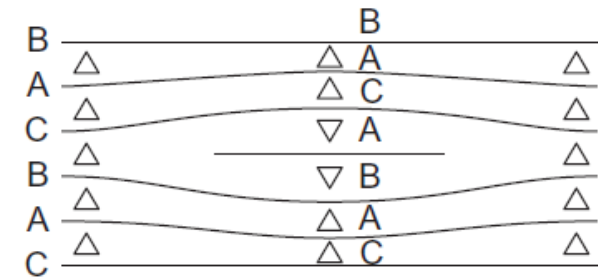
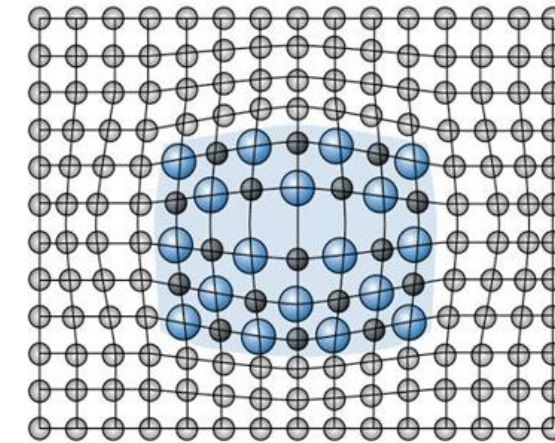
(b)



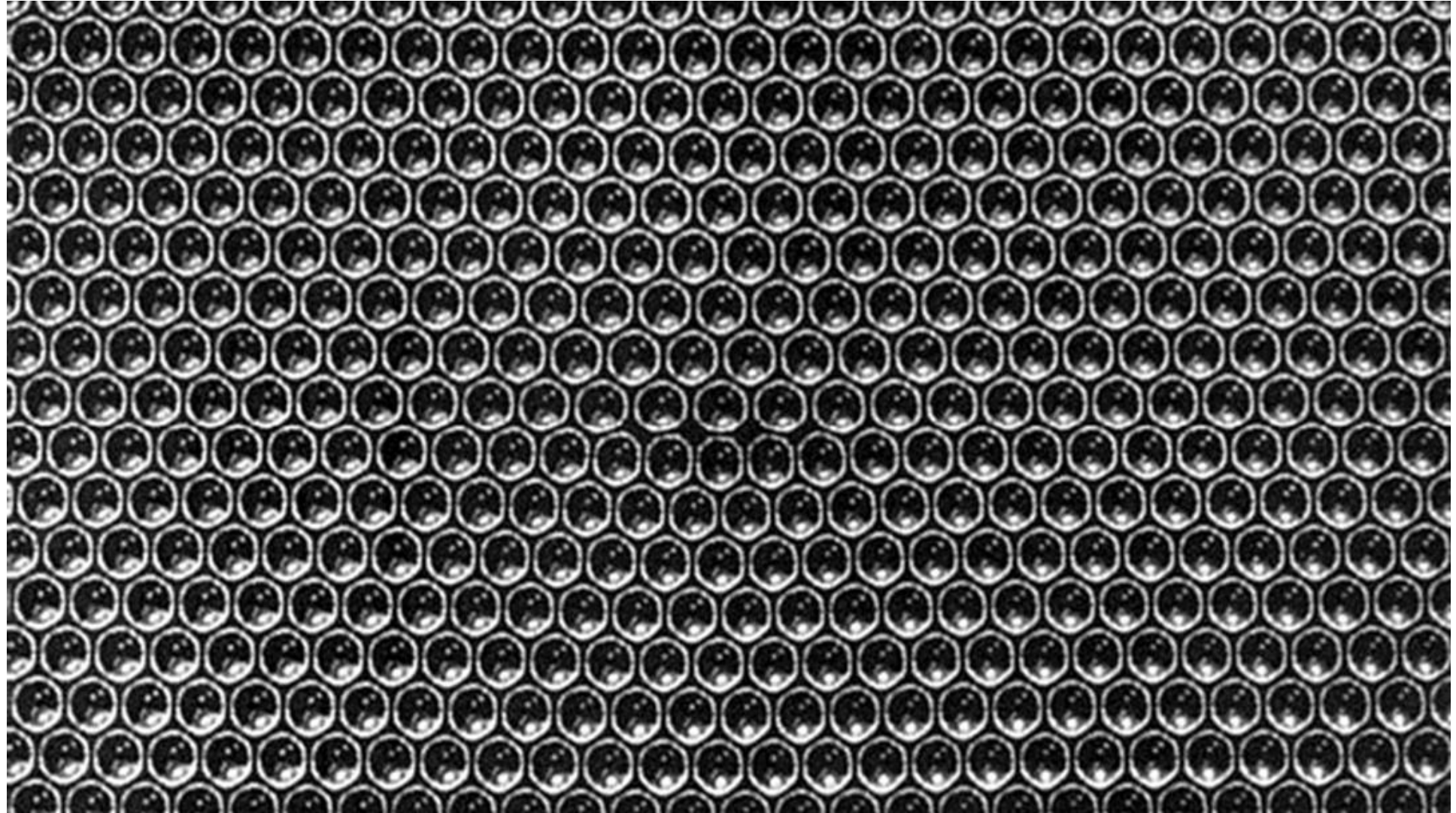
(c)



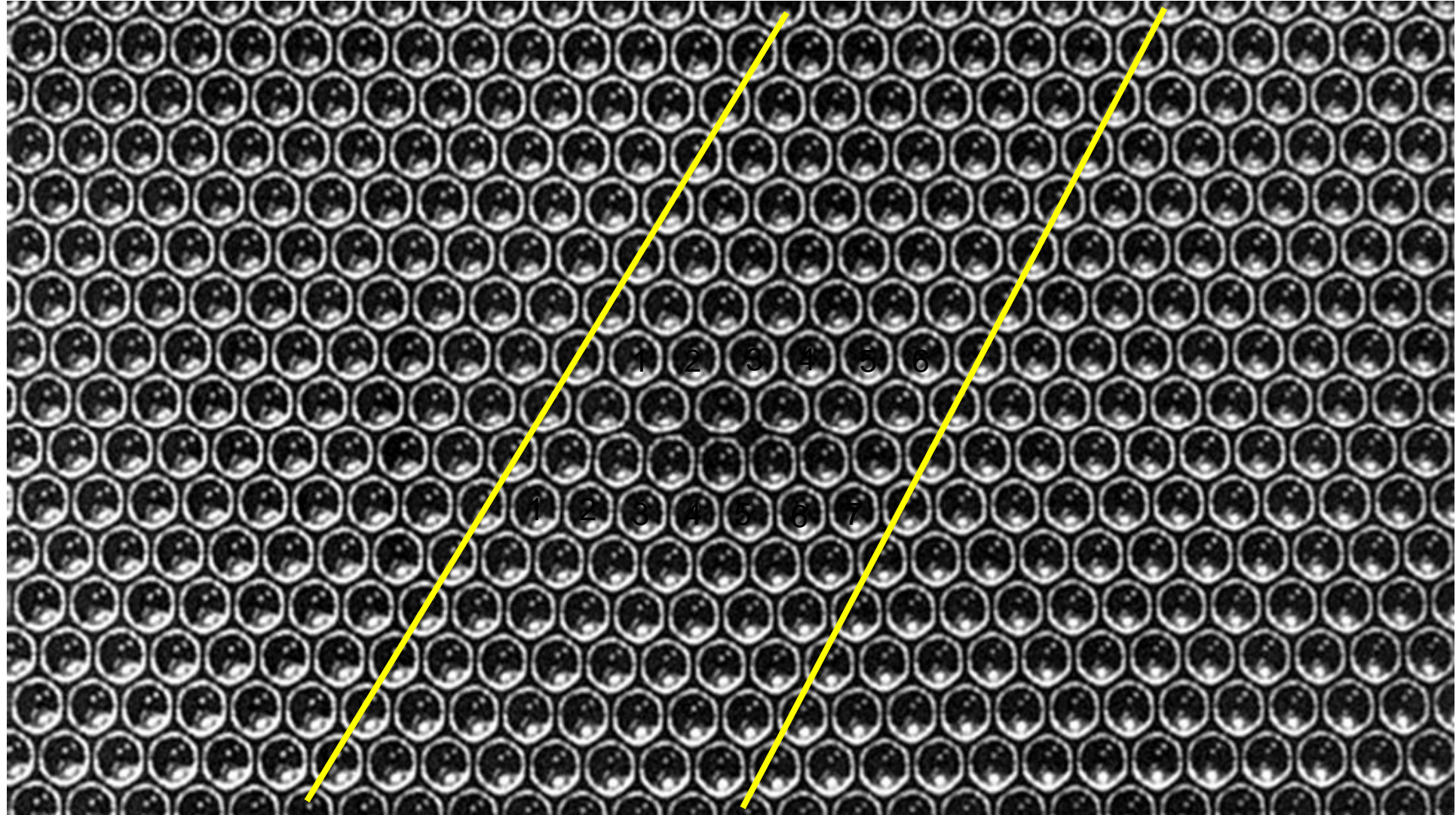
(d)



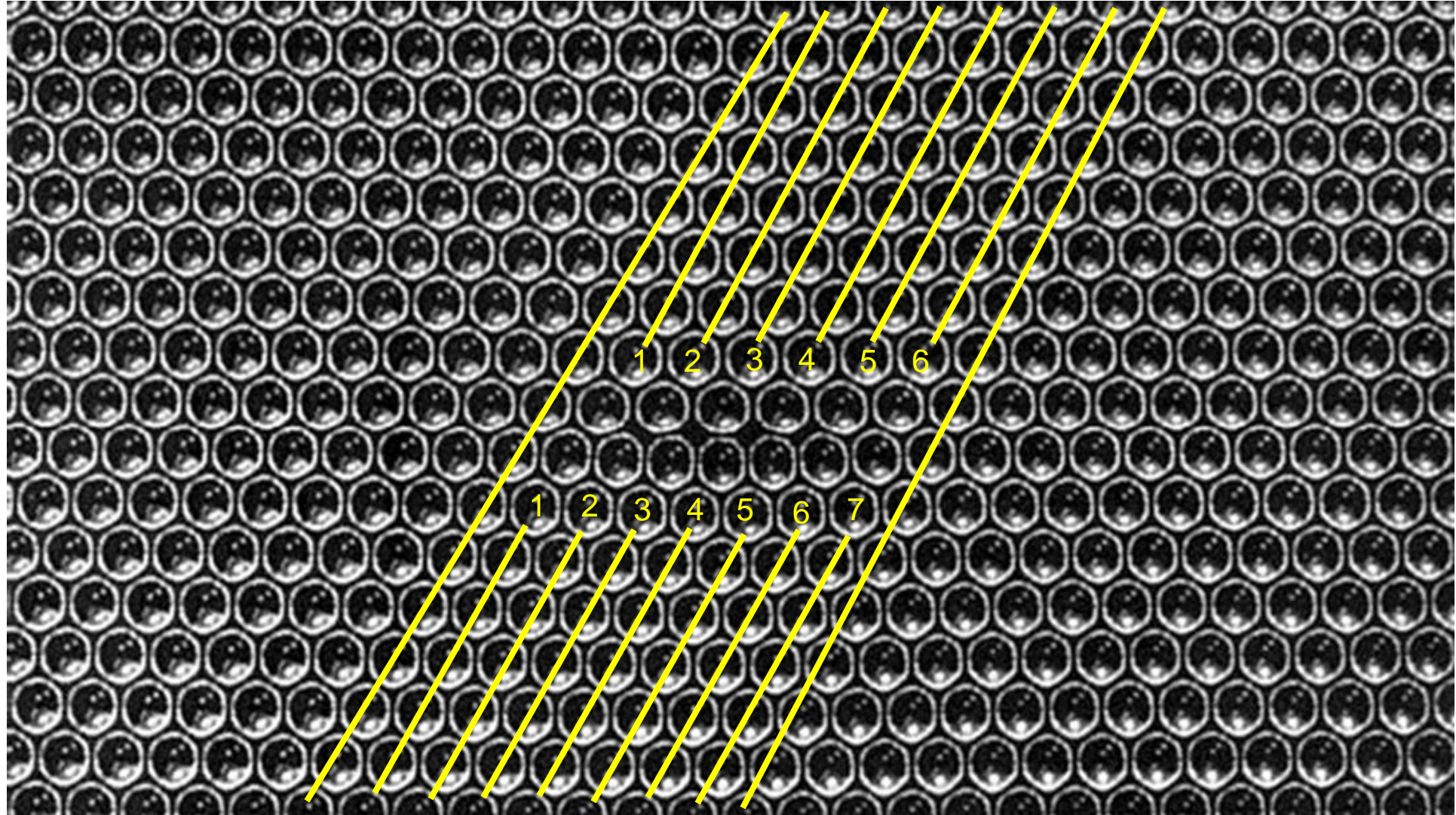
Dislocation



Dislocation

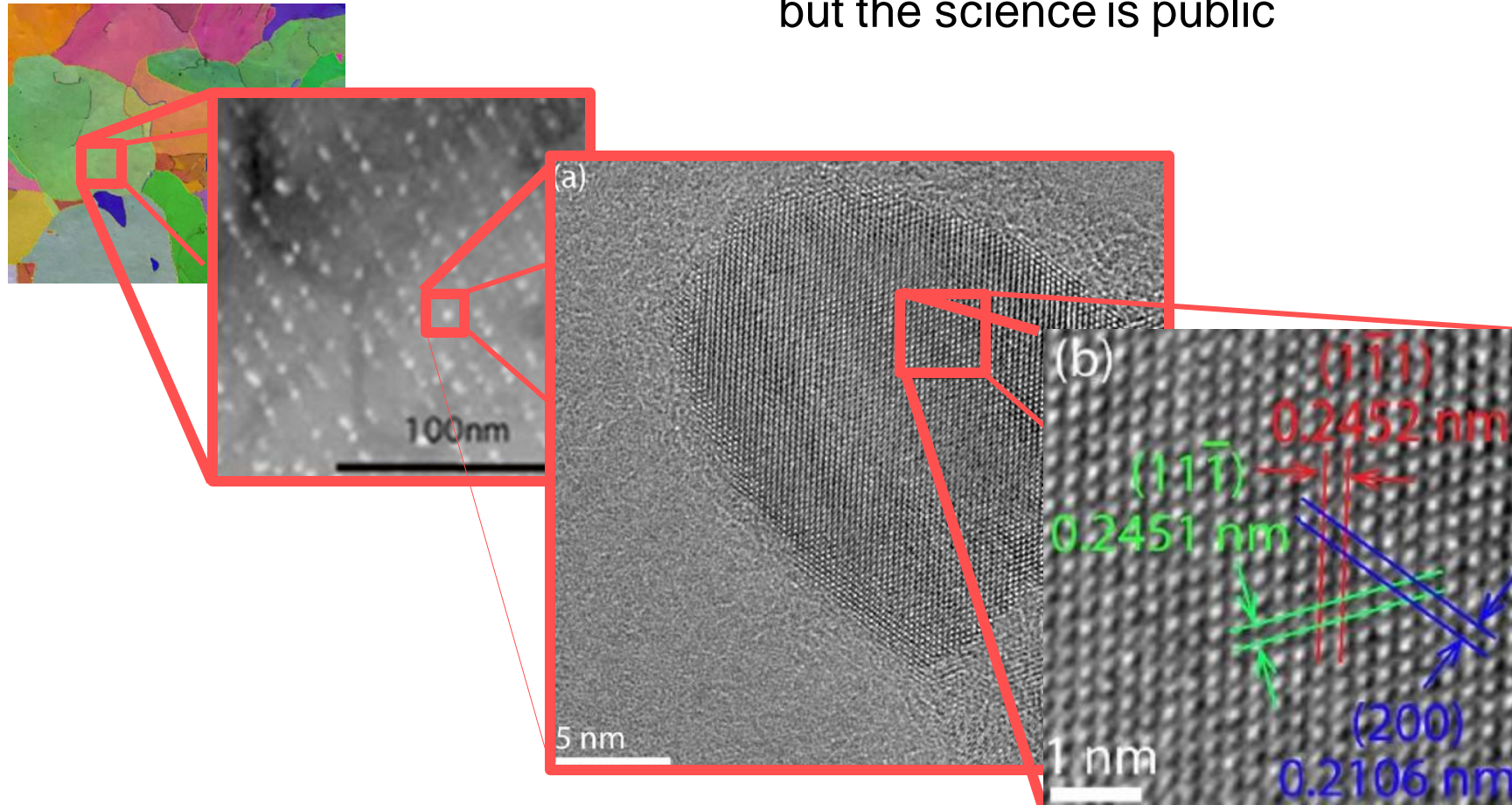


Dislocation

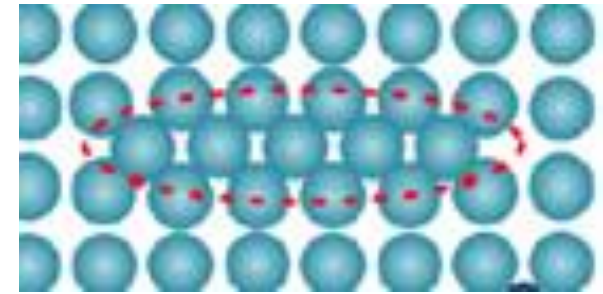
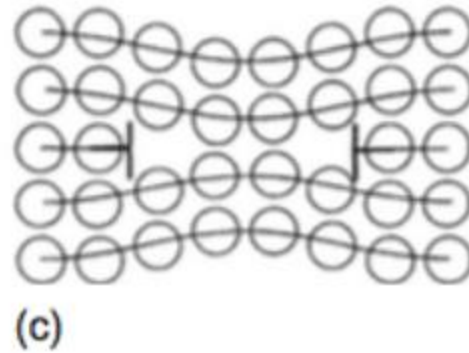
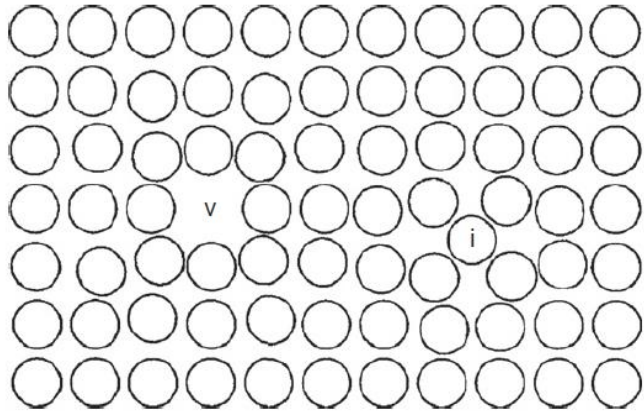


Hierarchical structure of steel: modern blacksmith's secret

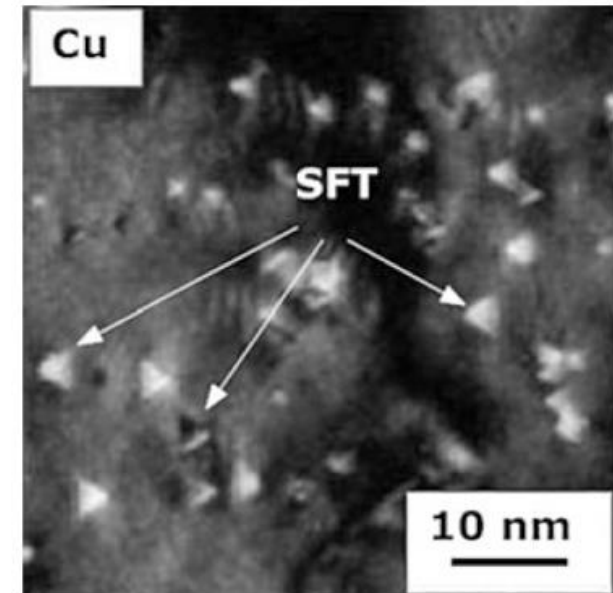
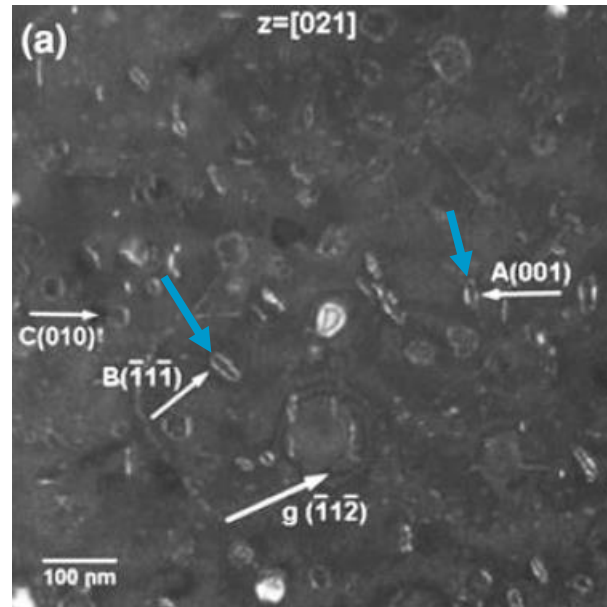
but the science is public



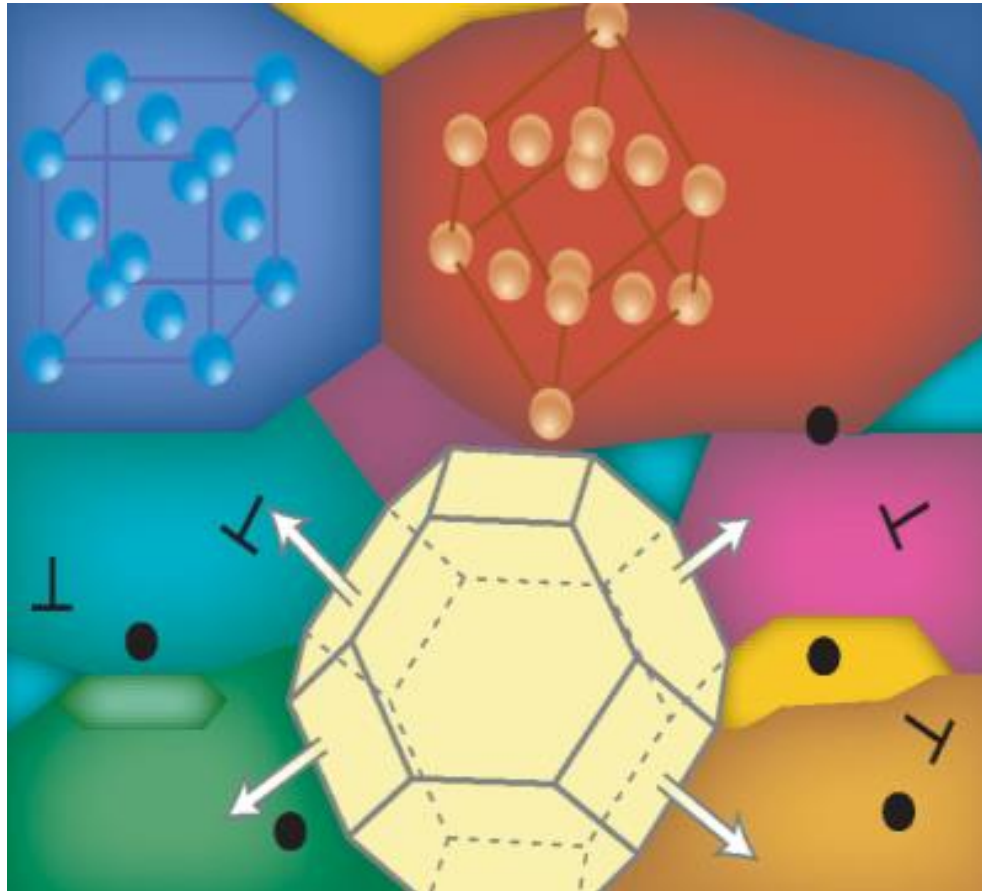
Common defects due to neutron irradiation



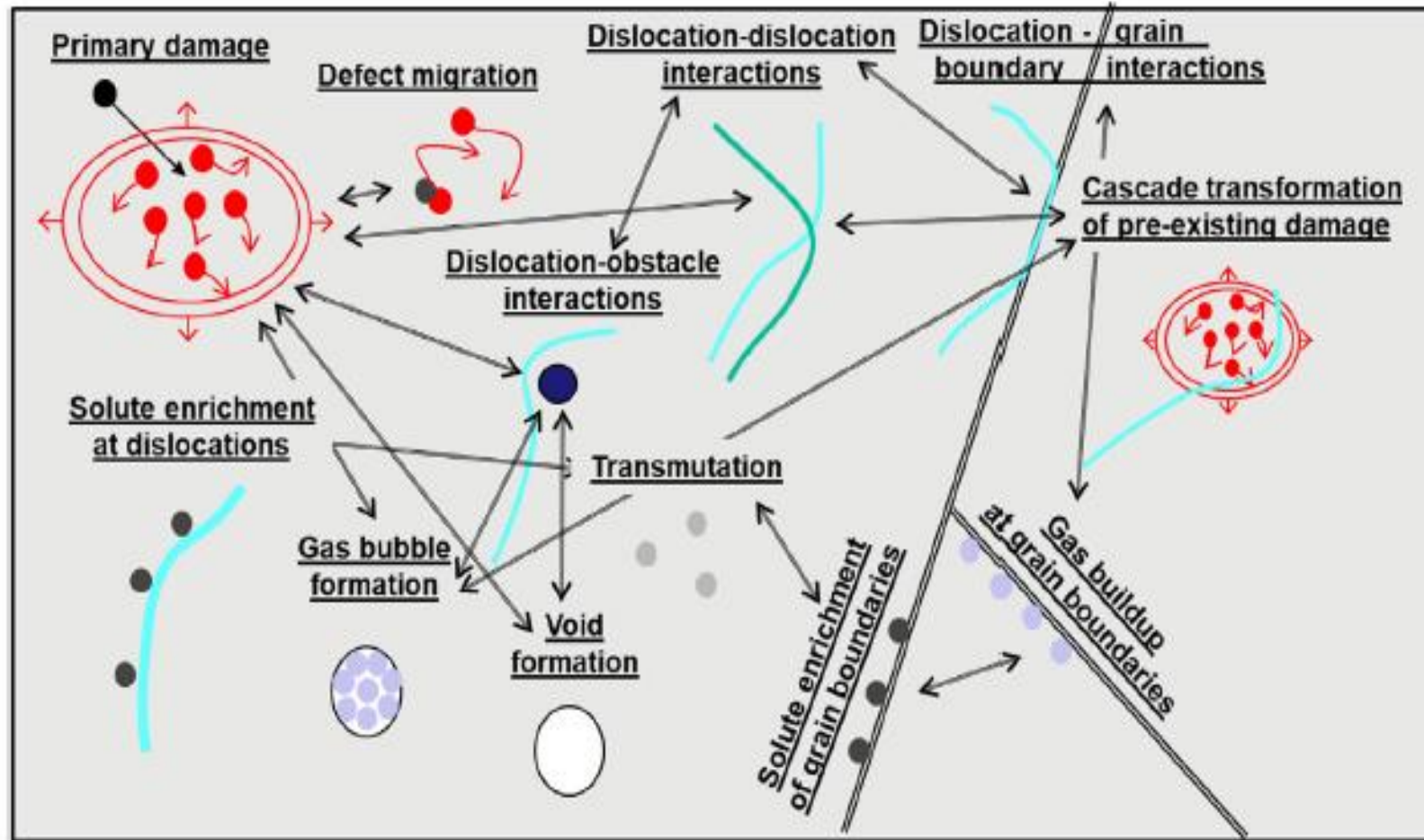
- Self-interstitial atoms
- Vacancies
- Dislocations: interstitial and vacancy loops
- Stacking-fault tetrahedra
- Non-equilibrium precipitates
- Voids & bubbles



Through-process microstructure model



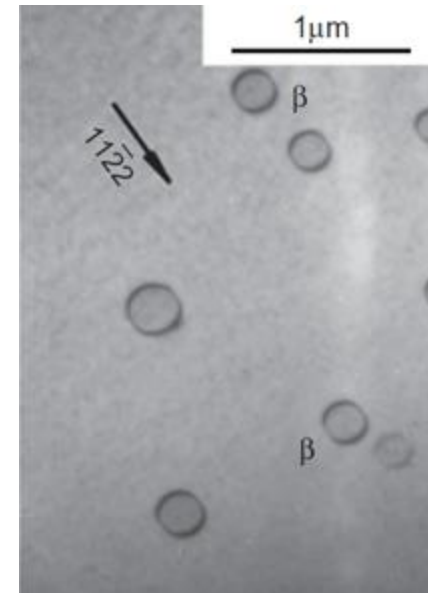
Neutron irradiation: life-time microstructure model



What can we learn from each other?

Perfect imperfections are beautiful

Faulted imperfections are also beautiful



Bedankt voor uw aandacht

S. Erik Offerman