Dislocation movement

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Dislocation movement

A dislocation line cannot end abruptly inside a crystal

It can end on

- Grain boundaries
- Free surfaces
- On other dislocation at a point called a node
- On itself forming a loop

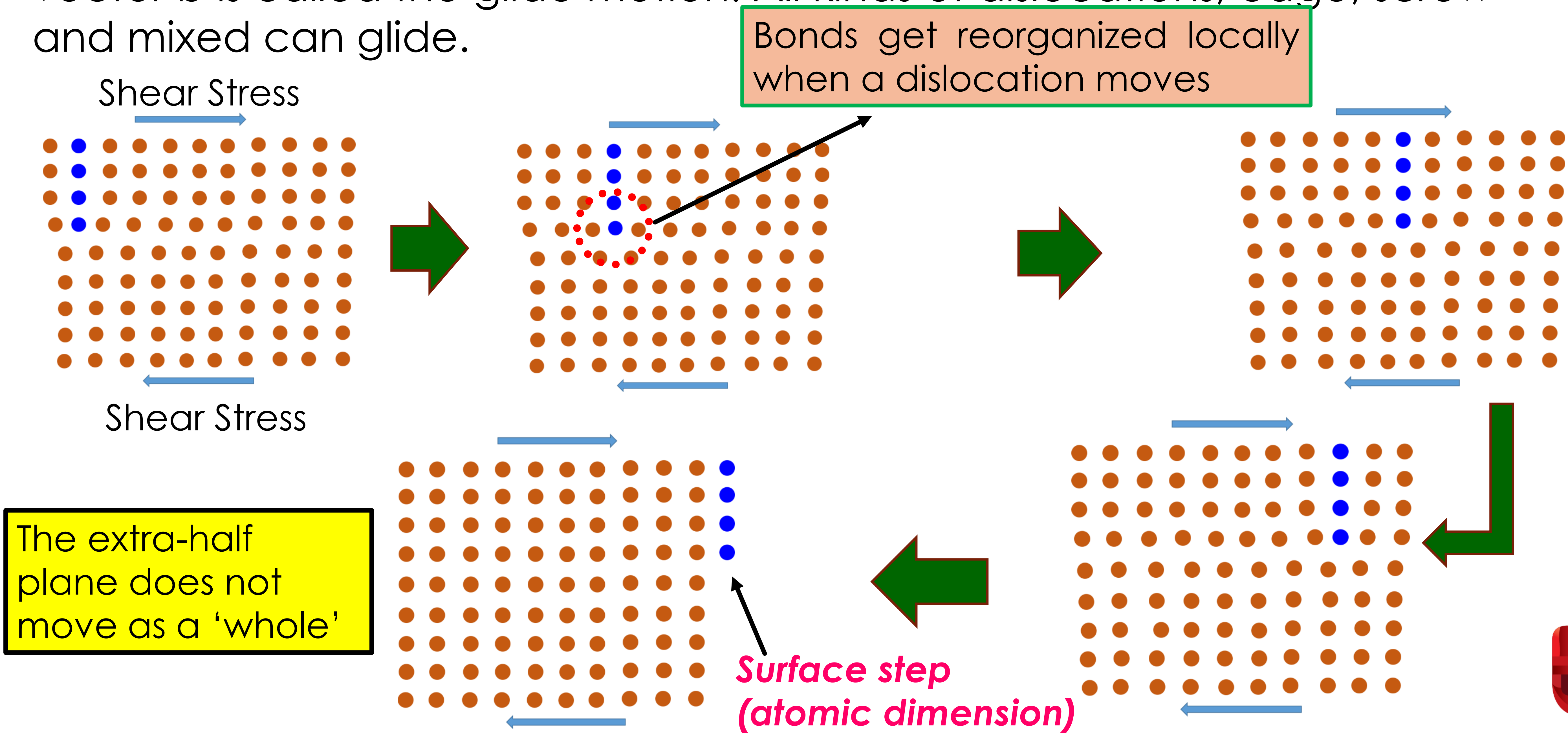
Dislocation Motion

Type of dislocation motion

- ❑Glide (for edge dislocation and mixed dislocation)
- ❑Cross-slip (for screw dislocation only)
- ❑Climb (Edge dislocation only)

Glide Motion

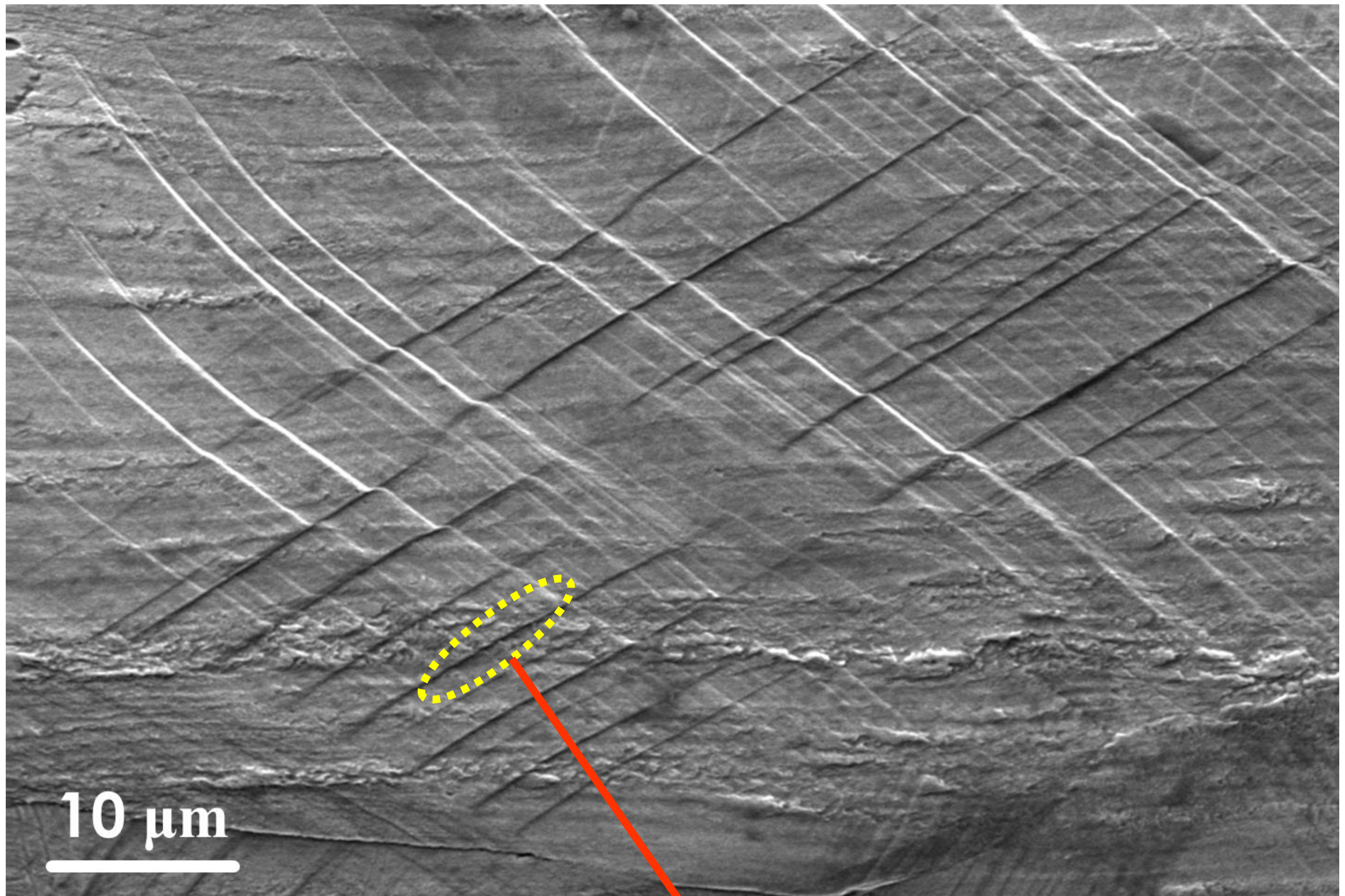
Glide is a motion of a dislocation in its own slip plane. The motion of a dislocation on a plane that contains the direction vector t and the Burgers vector b is called the glide motion. All kinds of dislocations, edge, screw and mixed can glide.



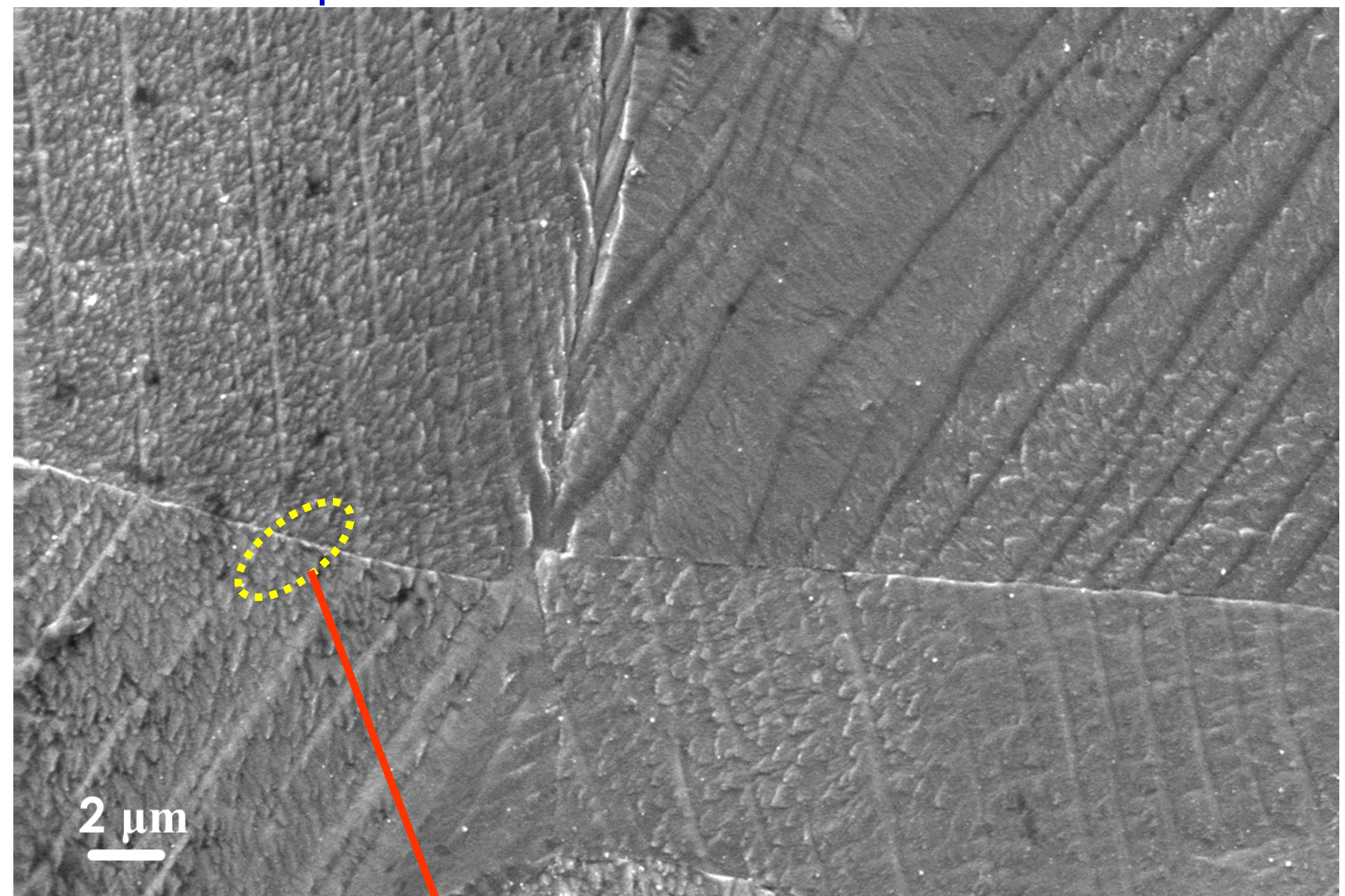
Glide Motion

GLIDE/ SLIP : CONSERVATIVE MOVEMENT: Does not results in addition or subtraction atoms from the dislocation line.

Observation of GLIDE/ SLIP using electron microscope



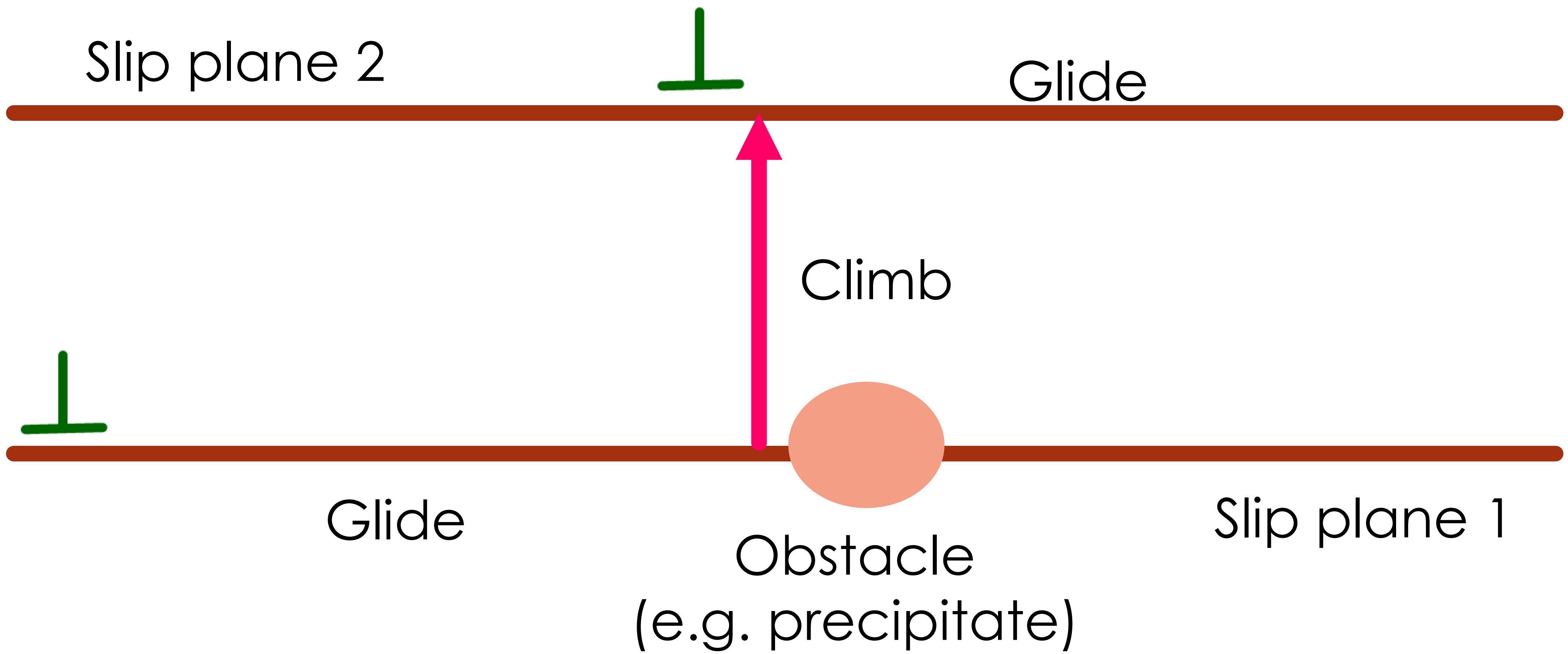
Surface steps (slip lines) visible in a Scanning Electron Micrograph



Slip lines (which are crystallographic markers) 'reflecting across' a twin boundary in Cu

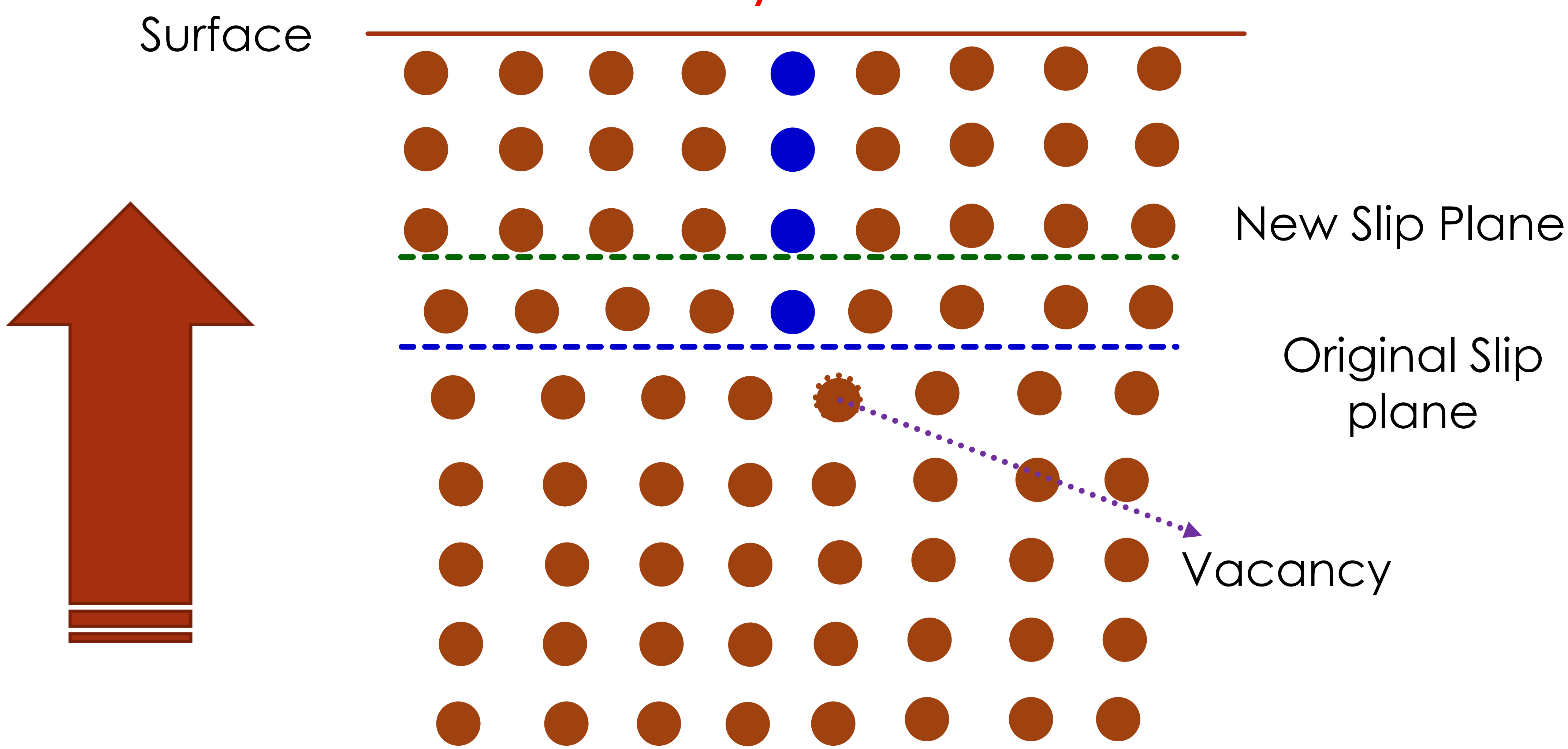
Climb Motion of Edge Dislocation

The motion of an edge dislocation from its slip plane to an adjacent parallel slip plane.



Climb Motion of Edge Dislocation

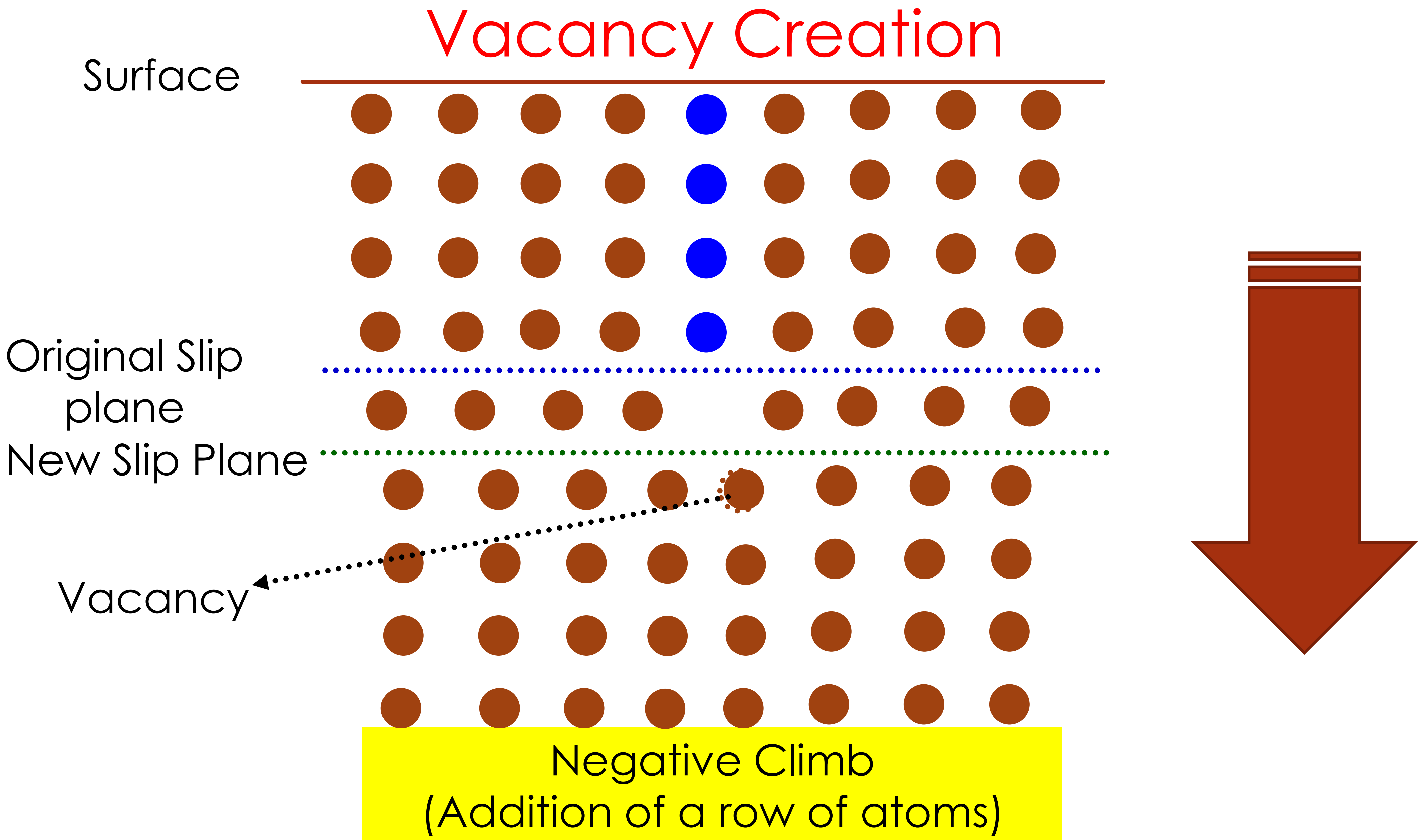
Vacancy Annihilation



Positive Climb
(Removal of a row of atoms)

Positive climb leads to decease in vacancy concentration in the crystal

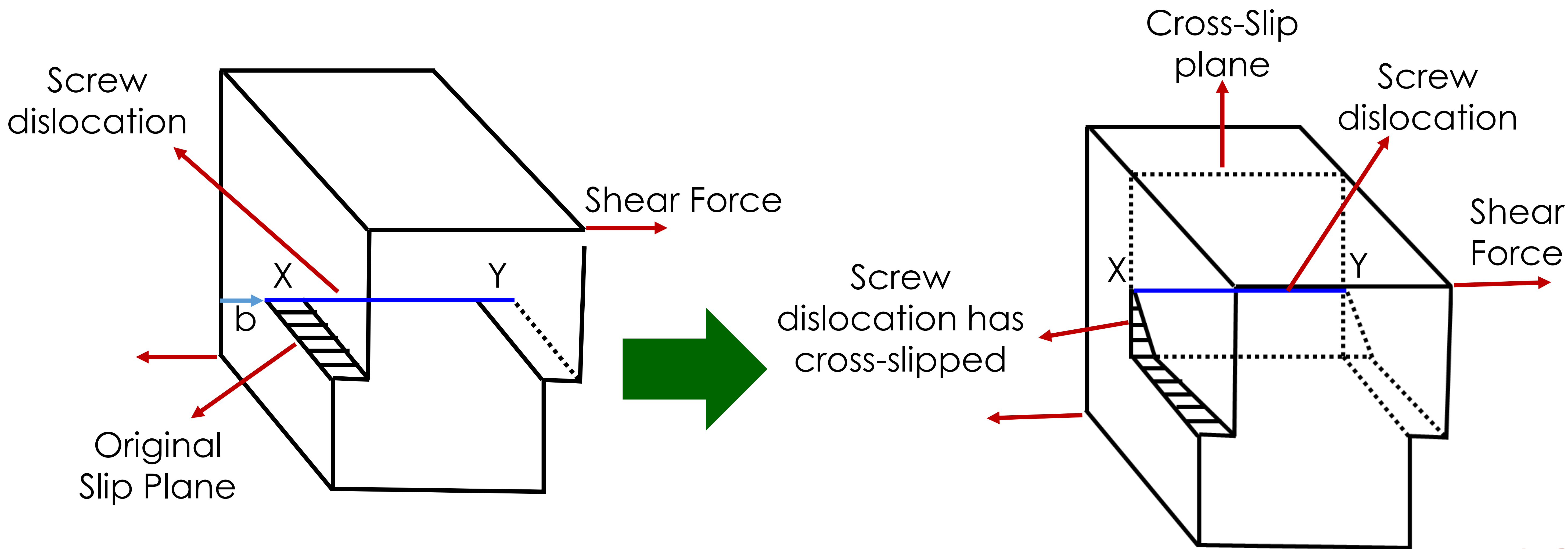
Climb Motion of Edge Dislocation



Negative climb leads to an increase in vacancy concentration in the crystal

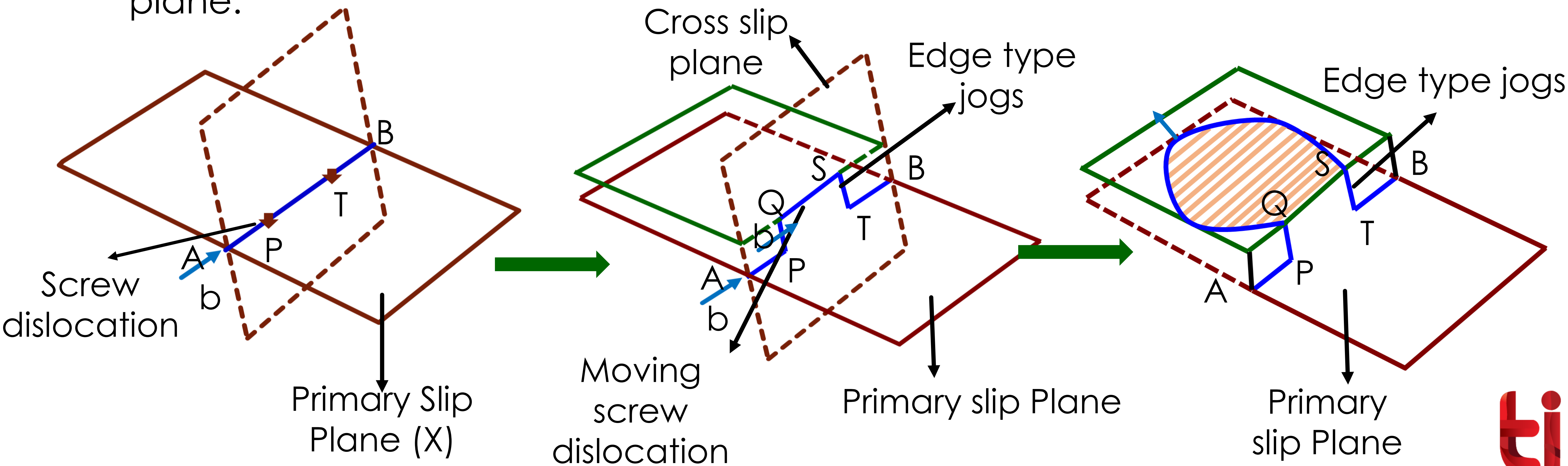
Cross Slip of Screw Dislocation

1. Motion of a screw dislocation during cross-slip: screw dislocation XY moving on the horizontal plane and shifted it's slip plane from horizontal to the inclined plane, called as cross-slip plane.



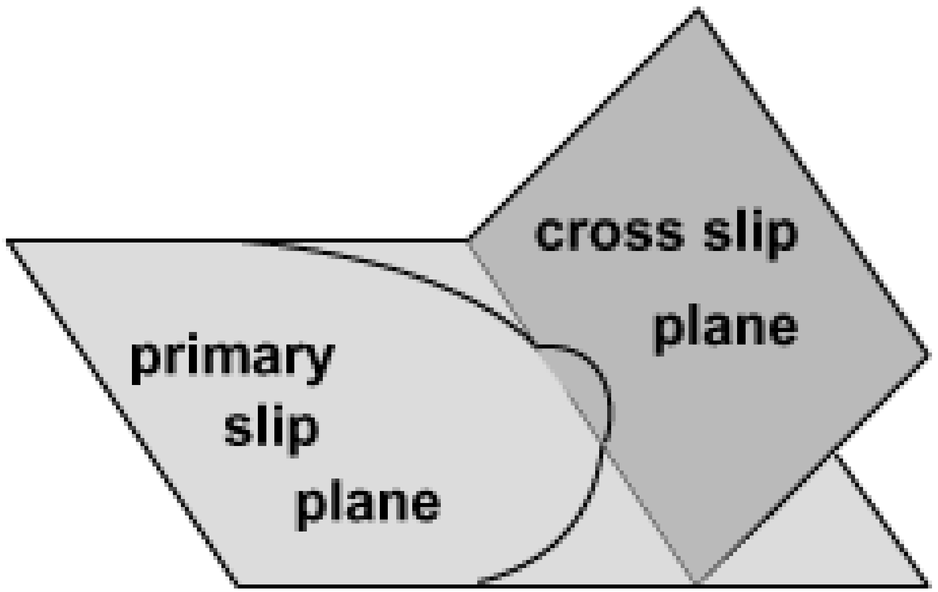
Cross Slip of Screw Dislocation

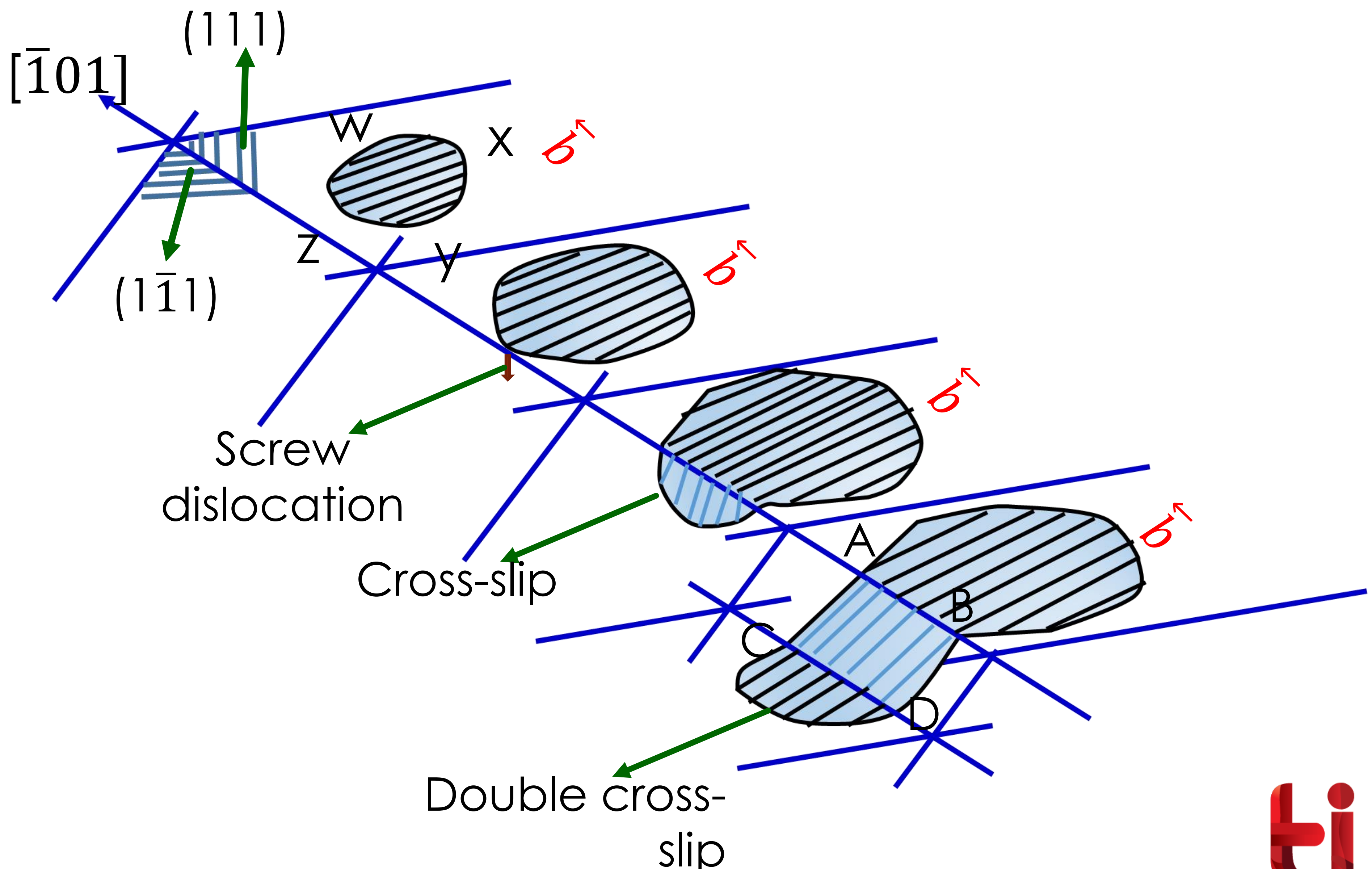
- **2. Double cross-slip dislocation**
- A screw dislocation AB is gliding on a primary slip plane (X).
- AP and TB parts of screw dislocation do not cross-slip but QS part of dislocation cross-slip to another plane. When it moved on cross-slip plane two edge type jogs PQ and ST are created.
- The part of screw dislocation QS now double cross-slips as it has changed its motion to another plane primary plane which is parallel to the original slip plane.



Cross Slip of Screw Dislocation

Cross-slip in a face cantered cubic crystal: The screw dislocation move in {111} type plane but can switch from {111} type plane to another if it contains the direction of $\vec{b}$.





Summary

1. Only the edge dislocation can have climb movement.
2. Only the screw dislocation can have cross slip movement.
3. Both edge dislocation and mixed dislocation can have glide movement.
4. In positive climb motion, there is annihilation of vacancies.
5. In negative climb motion, there is generation of vacancies.

Assignment

1. A positive edge dislocation 1mm long climbs down by 2 μm in a Polonium crystal whose radius is 1.7 Å, Calculate the number of vacancies created or lost.