PLASTIC DEFORMATION

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CONTENTS

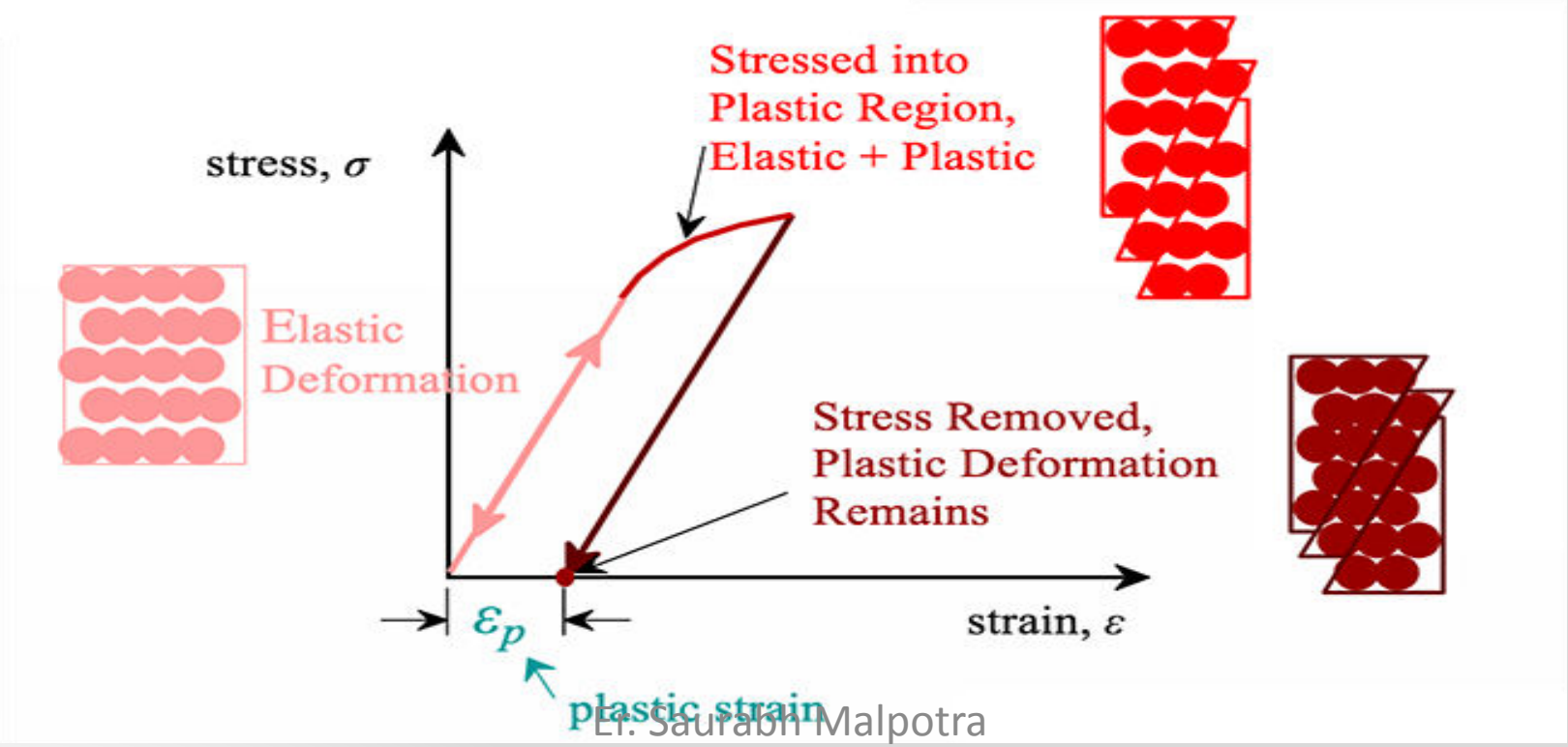
- Plastic deformation
- Plastic deformation of single crystals
- Plastic deformation by slip
- Plastic deformation by twinning.

PLASTIC DEFORMATION

- If the solid body is loaded beyond the elastic limit, the body will experience a permanent change in shape and size, even if the load is removed .
- Plastic deformation of metals and alloys is generally studied under two categories namely,

i. Plastic deformation of single crystals.

ii. Plastic deformation of polycrystalline materials



- Plastic deformation of single crystals involve the study of one single crystal and observing how it behaves under stress.
- A single crystal is nothing but a single grain and has no grain boundaries.
- Plastic deformation in single crystals may take place by

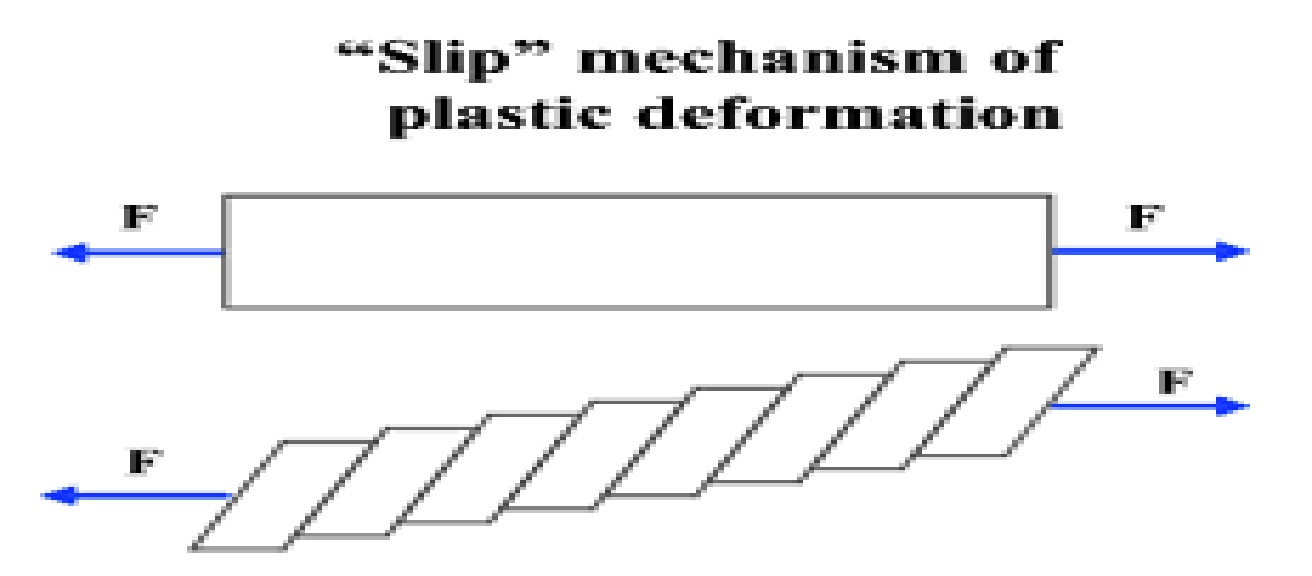
i. Slip

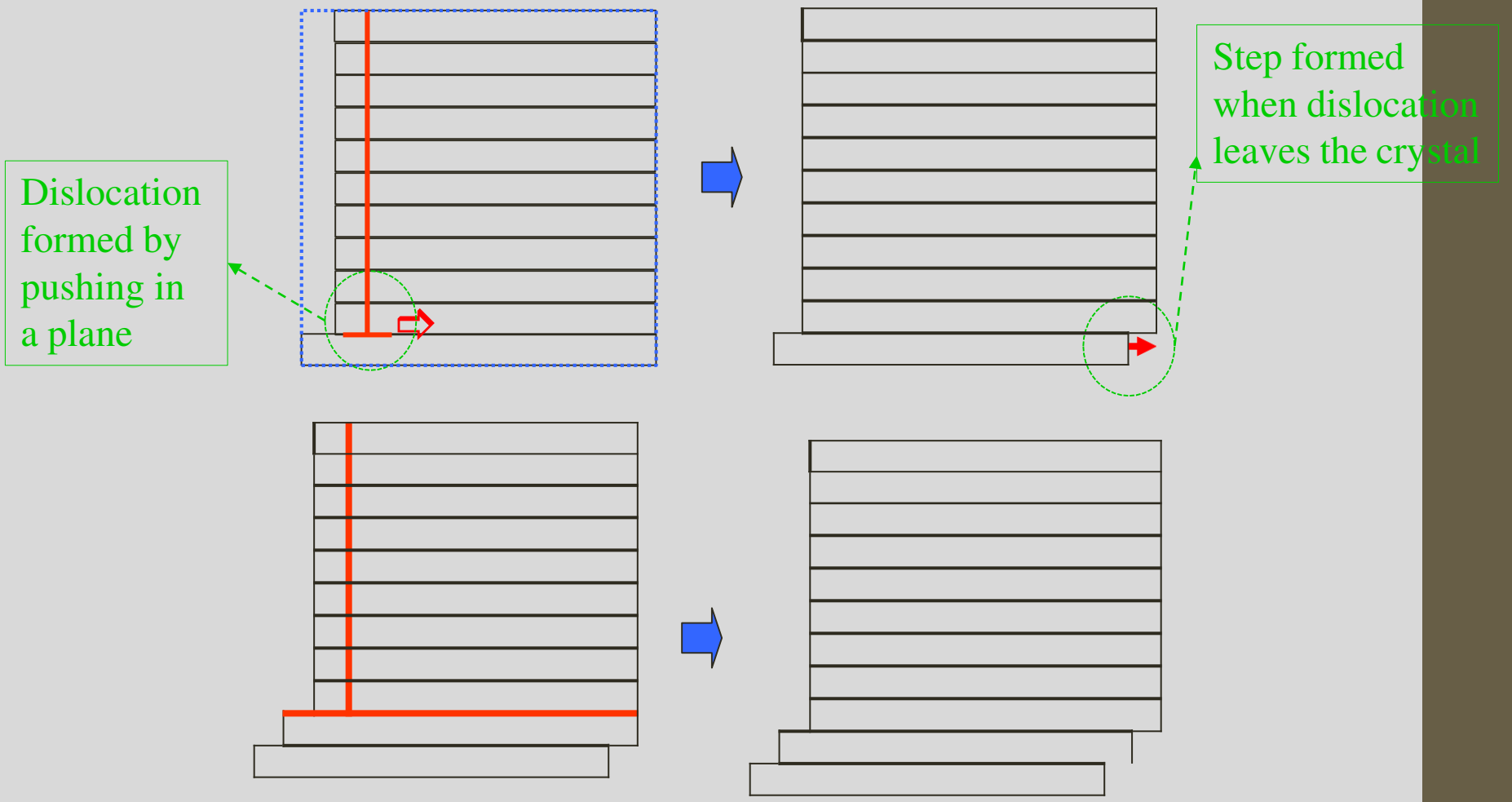
ii. Twinning or

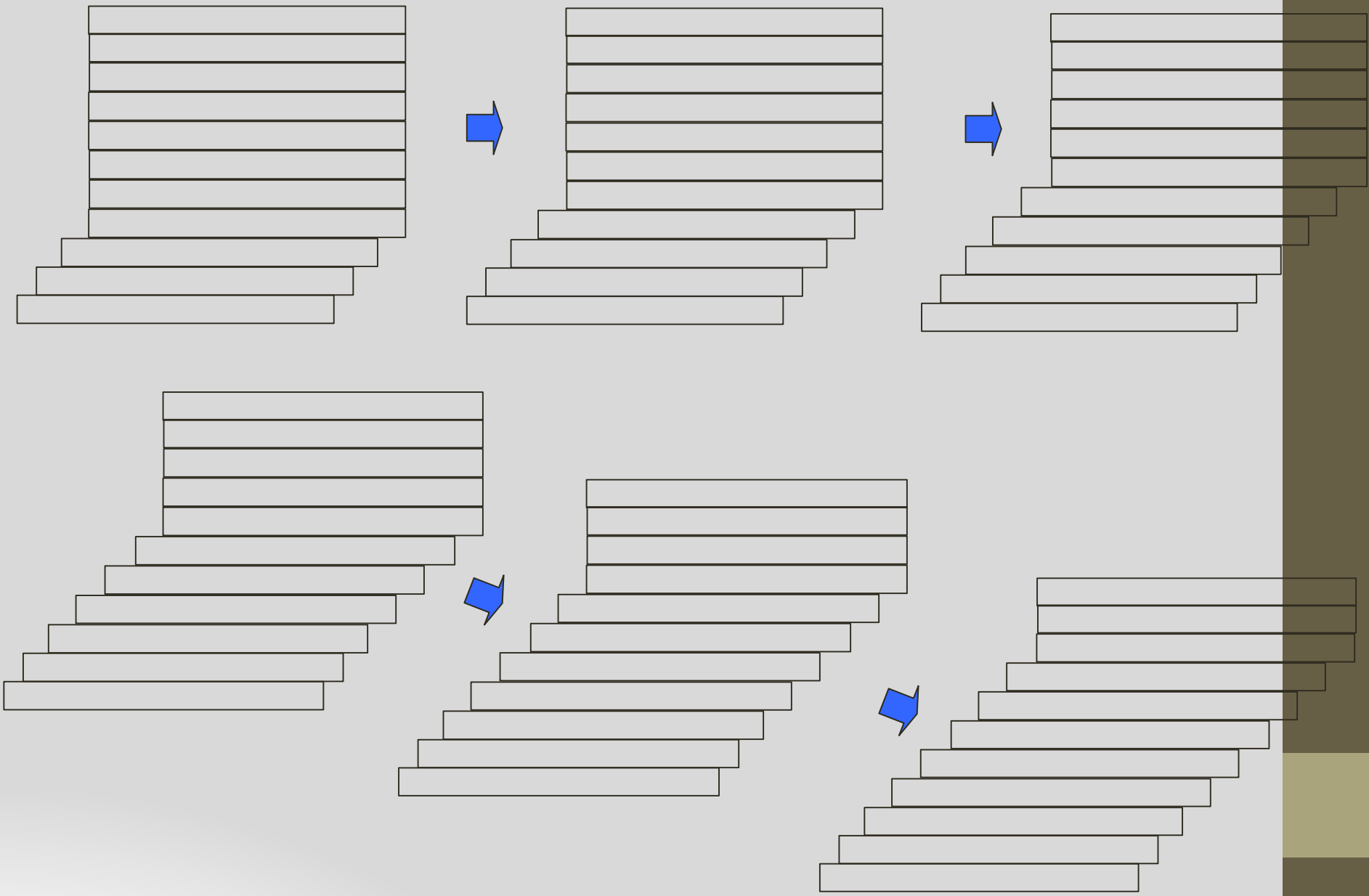
iii. a combination of both.

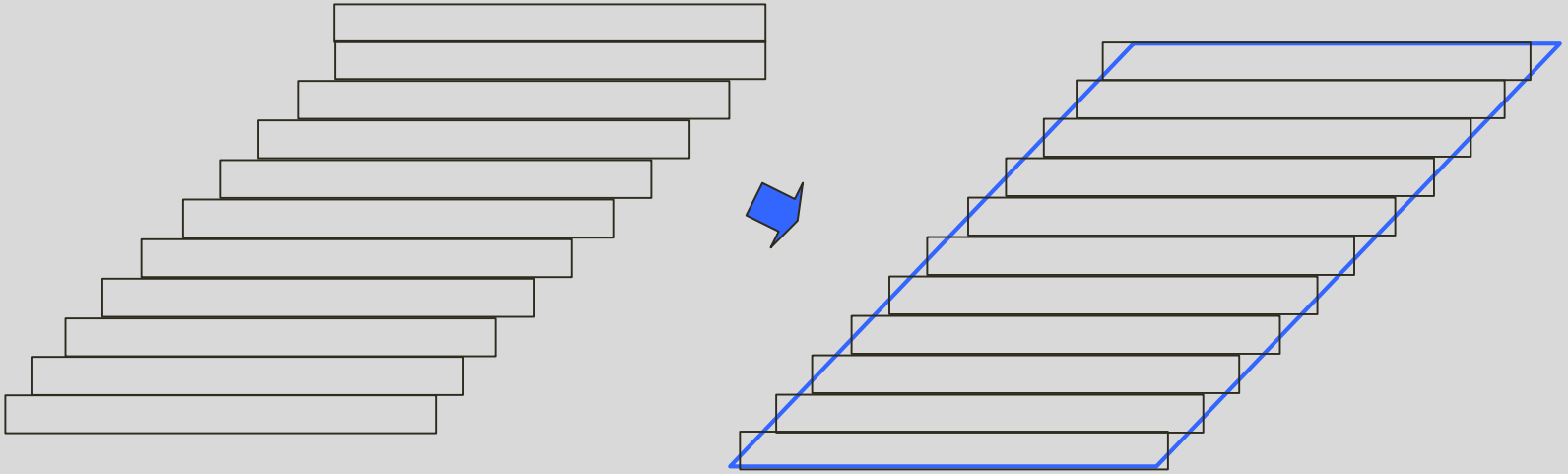
PLASTIC DEFORMATION BY SLIP

- Slip is the most common mode of plastic deformation among crystals.
- When a single crystal in tension is stressed beyond its elastic limit, a step appears such that the single crystal divides into two blocks .
- When the tensile load is further increased, the blocks become again divided and relative displacement takes place.
- Slip occurs due to the movement of dislocations through the crystal as shown in below figure.

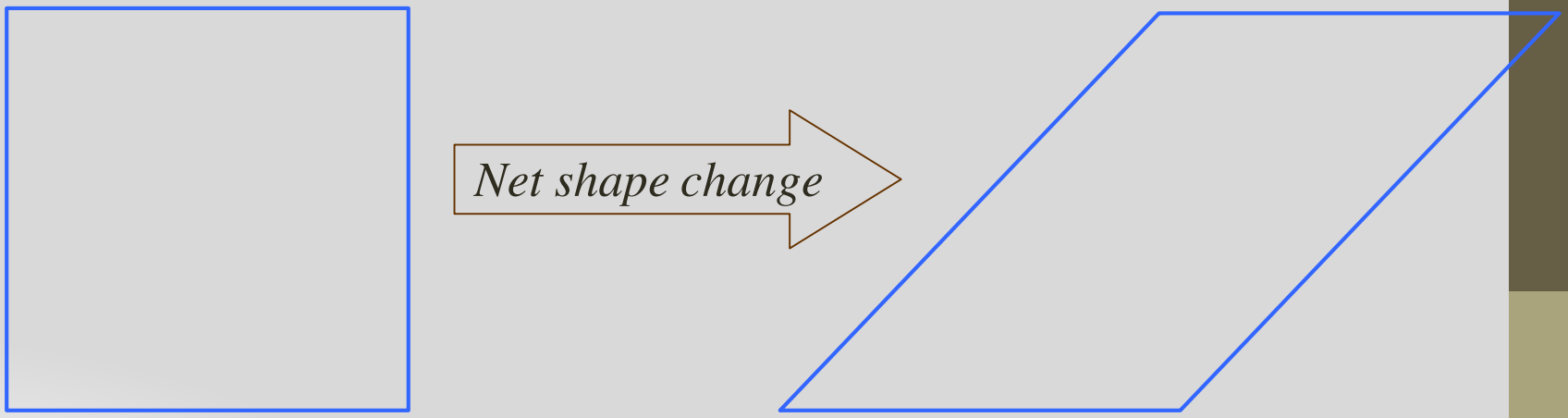



Dislocation formed by pushing in a plane
Step formed when dislocation leaves the crystal



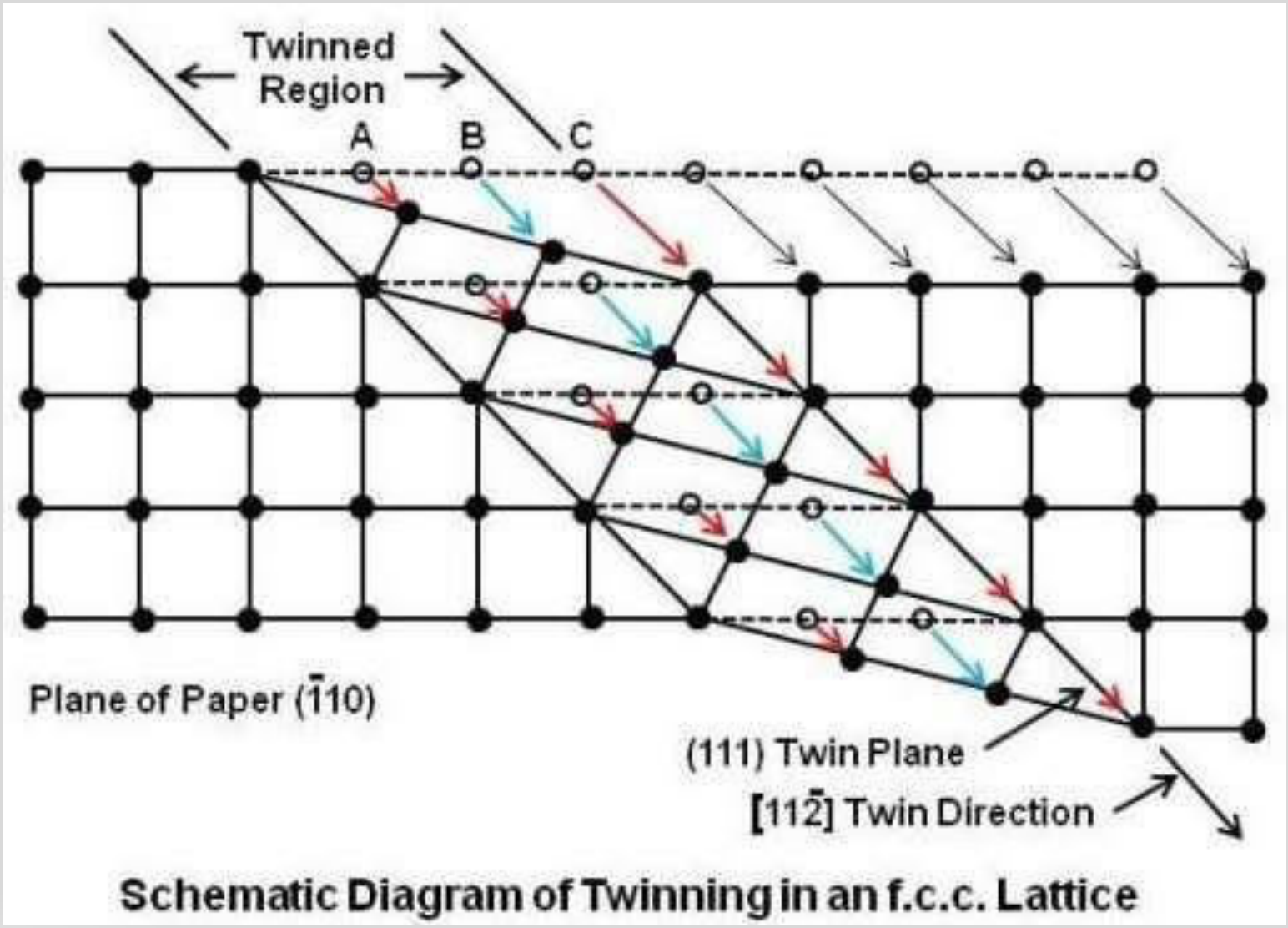


This sequence of events finally leads to deformed shape which can be approximated to a rhombus

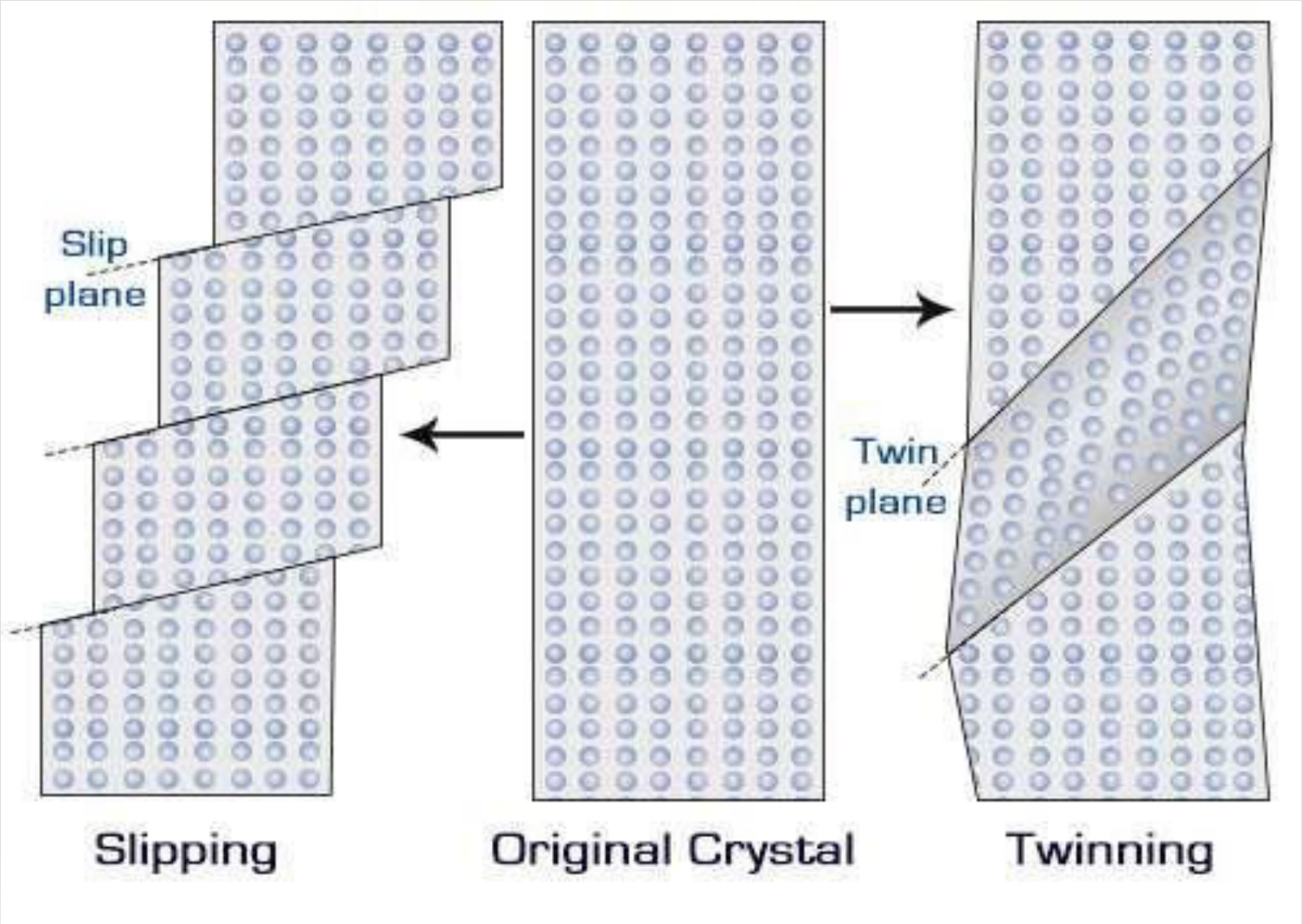


PLASTIC DEFORMATION BY TWINNING

- In twinning each plane of atoms move through a definite distance and in the same direction.
- The extent of movement of each plane is proportional to its distance from the twinning plane.
- When a shear stress is applied, the crystal will twin about the twinning plane in such a way that the region to the left of the twinning plane is not deformed whereas the region to the right is deformed.
- The atomic arrangement on either side of the twinned plane is in such a way that they are mirror reflections of each other.



Schematic Diagram of Twinning in an f.c.c. Lattice


Slip
plane
Twin
plane
Slipping
Original Crystal
Twinning

THANK YOU

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