Deformation texture of HCP Metals and alloys
• Deformation texture of HCP metals and alloys is generally governed by the axial \((c/a)\) ratio of the unit cell, as this ratio dictates the operative slip and twin systems.

Major criterion: \(c/a\) ratio

- Ideal, \(1.633\)
- More than ideal
- Less than ideal
Texture evolution after uniaxial deformation

Hexagonal metals respond differently to uniaxial deformation

- Mg has simple $[10 \bar{1}0]$ fibre texture, if forming is done at lower temperature

- $[2\bar{1}\bar{1}0]$ when working temperature as above 450 °C

- Zn has $[0001]$ about 70 ° from the wire axis
  - spiral texture after severe drawing

- after smaller reductions, $[0001]$ is parallel to the wire axis

- Zr and Ti have $[10\bar{1}0]$ fibre texture
  - cylindrical texture

Twinning is responsible for removing the wire axis parallel to the $[0001]$ planes.
Rolling textures:

- c/a ratio, strain rate, temperature and chemical composition (e.g. oxygen content) plays important role

Schematic representation of typical rolling texture in hexagonal metals - 0002 pole figures for different class of HCP metals and alloys

- c/a ~1.632
  - e.g. Magnesium

- c/a >1.632
  - e.g. Zinc, Cadmium

- c/a <1.632
  - e.g. Titanium, Zirconium
Texture variation is overall dictated by relative ease of slip and twinning. All the above mentioned factors affect the same.

Preferred orientation of the HCP unit cells in a unidirectionally rolled Ti–6Al–4V plate
Rolled sheet having grains with a strong basal orientations (a) and prismatic orientations (b), with corresponding (0002) pole figures.
Most of the important orientations in the texture of hexagonal metals and alloys appear in $\phi_2 = 0$ and $30^\circ$ sections of the ODF.

Key figure indicating the location of various texture components in the $\phi_2 = 0$ and $30^\circ$ sections of the ODF.

**Colour coding**

- Levels
- Values: 4.8, 4.4, 4.1, 3.8, 3.5, 3.2, 2.9, 2.3, 2.0, 1.7, 1.4, 1.1
- Max = 5.06
- Min = 0.13
Questions

1. What is the most important crystallographic parameter that decides the type of texture in hexagonal close packed materials?
2. What is the most important mechanism that decides the nature of texture in hexagonal close packed materials?
3. Which ODF sections are most important to examine the texture of HCP metals and alloys?
4. What are spiral and cylindrical textures in hexagonal metals and alloys?