Texture Development in Ti and Zr

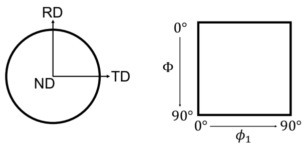
Practice Questions

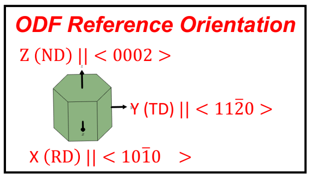
Please also try to answer these questions, which we will cover, along with others, in the "live" lecture.

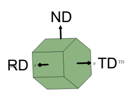
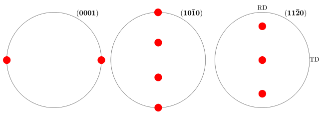
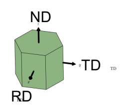
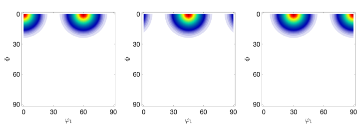
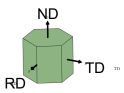
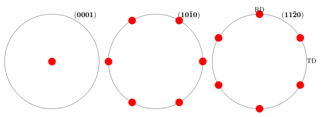
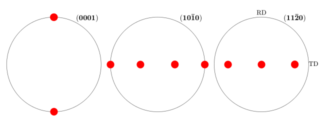
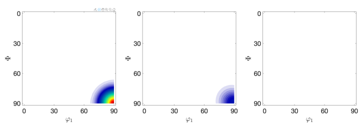
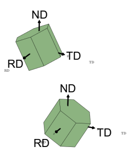
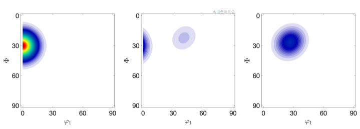
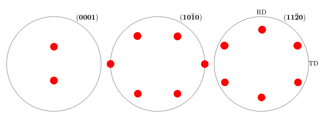
1. Fill in the missing parts of this table to show the different α-phase orientations and the corresponding idealised pole figures ($\{0002\}$, $\{10\bar{1}0\}$ and $\{11\bar{2}0\}$) and ODF slices (at $\phi_2 = 0°, 15°$ and $30°$), by roughly sketching the diagrams.

   (Remember, the Euler angles ϕ_1, Φ, ϕ_2 correspond to a rotation of Z, X', Z' from the reference orientation.)

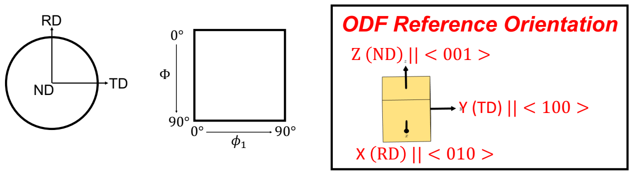
   The Miller-Bravais indices *notation* can be a neat way to express a single texture component in the form of $\{hkil\} < uvtw >$, which describe the hcp plane that lies parallel to ND and the crystal direction that aligns parallel to RD. In each case, also fill in the Miller-Bravais notation.

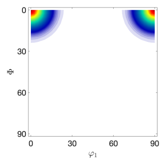
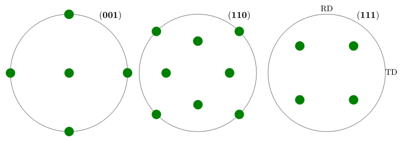
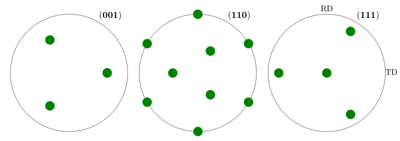
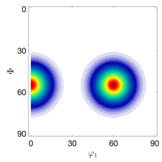
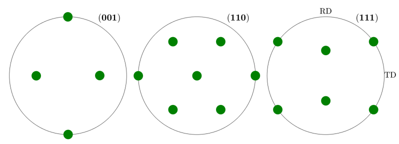
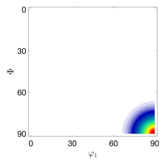




3D Schematic	***Pole Figures*** $\{0002\}$ $\{10\bar{1}0\}$ $\{11\bar{2}0\}$	***ODF Slices*** $\phi_2 = 0°$ $\phi_2 = 15°$ $\phi_2 = 30°$	***Miller Indices Notation*** $\{hkil\}$ in ND, $< uvtw >$ in RD
		**5.**	**8.**
	**1.**		$\{0002\} < 10\bar{1}0 >$
		**6.**	**9.**
2.			**10.**
	**3.**		
4.		**7.**	

2. Fill in the missing parts of this table to show the different β-phase orientations and the corresponding idealised pole figures ($\{001\}$, $\{110\}$ and $\{111\}$) and ODF slice (at $\phi_2 = 45°$), by roughly sketching the diagrams. In this case, the Miller indices notation is in the form of $\{hkl\} < uvw >$.

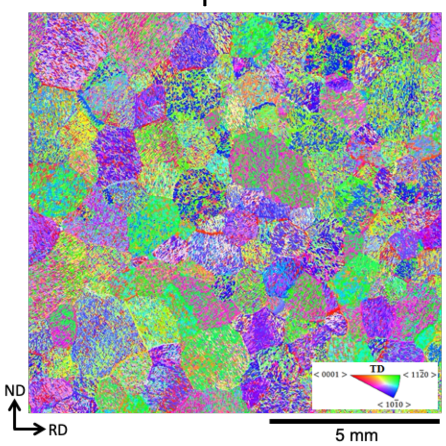


	$\{001\}$	$\{110\}$	$\{111\}$	$\phi_2 = 45°$	$\{hkil\}$ in ND, $< uvtw >$ in RD
1.		**2.**			**3.** “Rotated Cube” component
4.				**5.**	**6.** “Cube” component
7.					**8.** Part of the “γ-fibre”
9.					**10.** “Goss” component

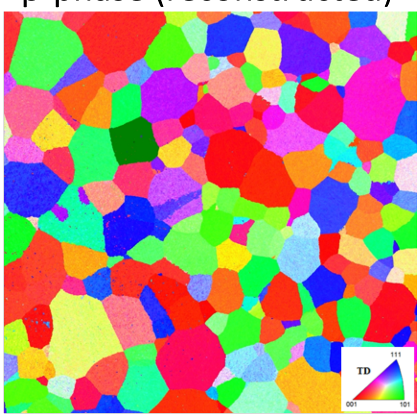
3. Describe in one or two sentences the microstructural features and the main cystallographic texture component (if there is one) in the following EBSD maps;

a) Dual-phase Zr-2.5Nb, hot-rolled and then beta-annealed (heated to high temperature in the full β-phase regime), followed by air-cooling. The high temperature β grains have been reproduced using a software reconstruction.

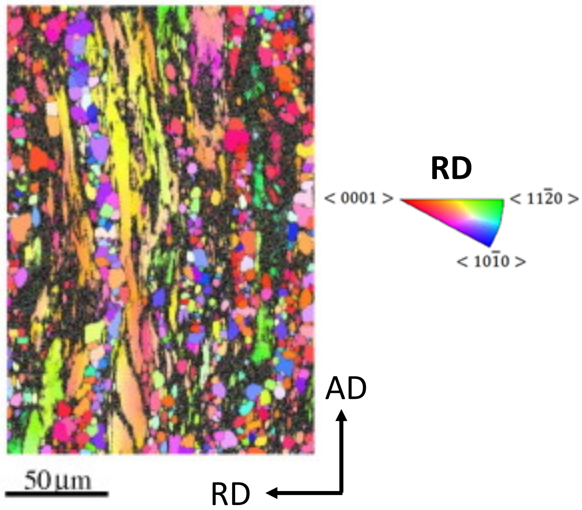
α-phase



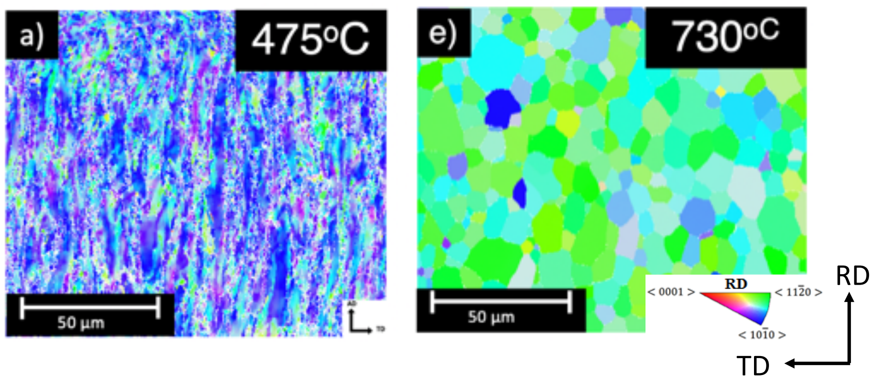
β-phase (reconstructed)



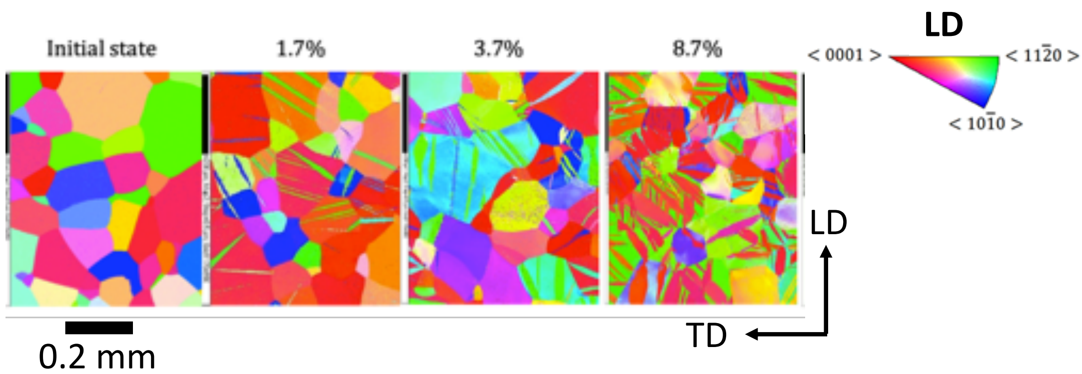
b) Zircaloy-4 alloy, pilgered rod and part-annealed. *Note, AD = axial direction, RD = radial direction.*



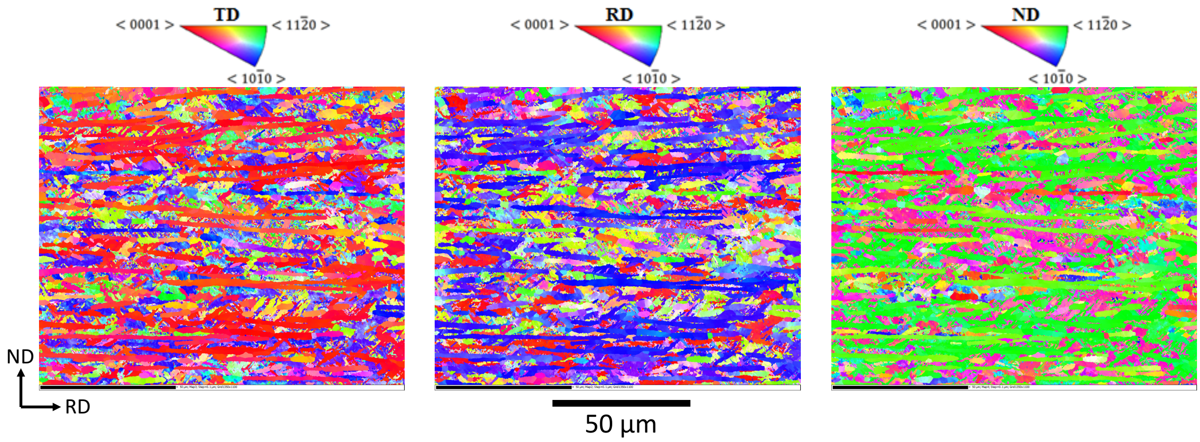
c) Single-phase zirconium cold-rolled and then annealed (at 2 different annealing temperatures). *Note, ND = normal direction, RD = rolling direction, TD = transverse direction.*



d) Ti2Al tensile specimen strained at room temperature to different strain increments. *Note, LD = loading direction, TD = transverse direction.*



e) Dual-phase Zr-2.5Nb alloy hot-rolled in the α + β phase regime and air-cooled.



a) Additively manufactured Ti-6Al-4V components of different thicknesses produced by electron beam melting. Software reconstruction has been used to show the hot solidification structure of the β-phase. *Note, BD = build direction, the direction on which layers of liquid Ti are added.*