The Effect of Heat Treatment on the Crystallographic Texture of Zr Alloy Excel Pressure Tube

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The Excel alloy (Zr- 3.5% Sn- 0.8% Mo- 0.8% Nb) is a promising material for Generation IV CANDU Super Critical Water (SCW) reactors pressure tube due to its high strength and superior creep resistance. It is a dual phase α-hcp and β-bcc alloy with the approximate α and β volume fractions of 87% and 13% respectively in the pseudo-equilibrium condition at room temperature [1].

It is known that the in-reactor deformation of the pressure tubes is a direct result of the crystallographic texture and a more random texture would give rise to less elongation of the pressure tubes.

A series of neutron diffraction texture measurements were carried out to study the effect of different heat treatments on the crystallographic texture of an Excel pressure tube as well as to investigate the variant selection during α → β → α phase transformation.

It was found that solution treatment at temperatures high in the α+β region followed by water-quenching or air-cooling to room temperature results in a more random texture compared to the as received pressure tube (Figure 1 and Table 1). Also it was found that variant selection happens during quenching, i.e. β → α' phase transformation.

Table 1 Resolved fraction of basal plane normals in the axial, f_a, transverse, f_t and radial, f_r, directions.

	As-received	890AC	890WQ	980WQ
f_a	0.05	0.12	0.27	0.33
f_t	0.67	0.55	0.41	0.35
f_r	0.27	0.32	0.32	0.32

Reference

[1] M. Sattari, R.A. Holt, M.R. Daymond, J. Nucl. Mater. (2013)

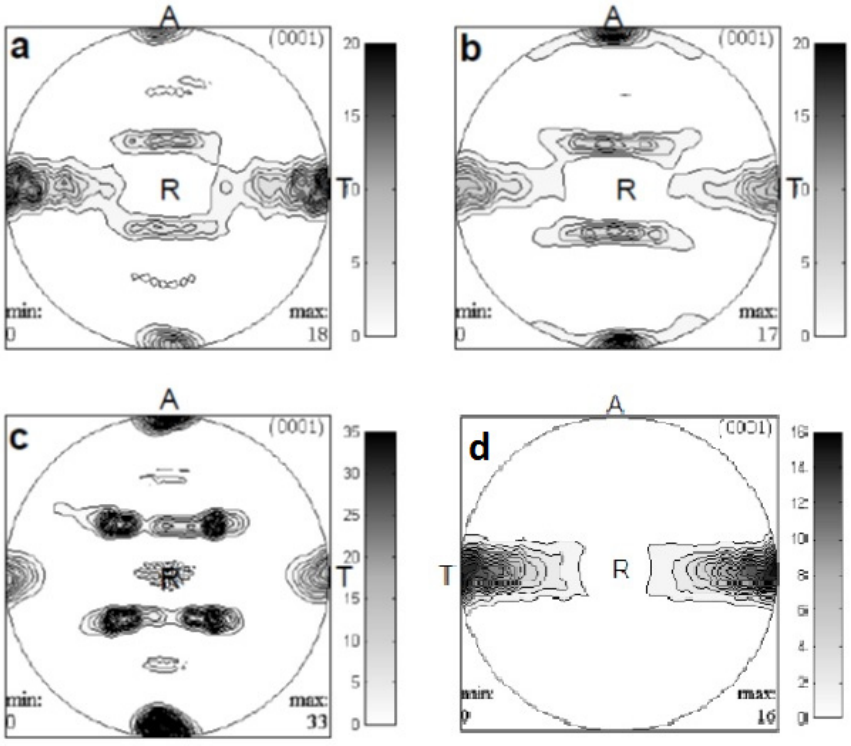

Figure 1 (0002) pole figure of (a) 890°C air-cooled (b) 890°C water-quenched (c) 980°C water-quenched samples and (d) as-received pressure tube.