s6.m2.p5 Features of Zr–Nb alloys structure loaded by spherical converging stress waves. N.I. Taluts(1), A.V. Dobromyslov(1), E.A. Kozlov(2) *(1) Institute of Metal Physics, Ural Division of Russian Academy of Sciences, 18 S.Kovalevskaya str., GSP-170, Ekaterinburg, 620219, Russia. e-mail: NinaTaluts@imp.uran.ru (2) Russian Federal Nuclear Center – Research Institute of Technical Physics, P.O.Box 245, Snezhinsk, Chelyabinsk region, 456770, Russia, e-mail: Kozlov@onti.ch70.chel.su*

Keywords: extreme conditions.

The study of the effect of spherical stress waves on the phase state, structure, and mechanical properties of metals and alloys is of great interest nowadays because this method of pulsed loading allows to obtain extremely high pressures and temperatures in rather large volume of material and to preserve specimens unbroken after such loading. The aim of this investigation was to study the structure and phase state of the Zr–Nb alloys loaded by spherical converging stress waves of the different intensity.

Two balls of the Zr–1wt% Nb alloy 35 and 32 mm in radii and two balls of the Zr–2.5wt% Nb alloy of the same sizes were subjected to the loading by spherical converging detonation waves of the different intensity. The initial pressure on the external surface of the balls was over 30 GPa. In the central areas of the balls, the pressures and temperatures, sufficient for the melting of the alloys directly at the shock-wave front, were reached at converging waves. The detailed analysis of the structure was performed using the X-ray diffraction analysis, the optical and transmission electron microscopy.

The specimens that were saved unbroken after the shock loading with spherical converging stress waves have the shape of a thick-wall spherical shell. A hollow, whose size was different in different balls, appeared in the central part of the initially continuous balls. In the case of high-intense loading, the area of instable plastic flow is observed near the hollow. The boundaries of instable plastic flow area are “protuberance-like”.

In the initial state, the alloys have a two-phase structure composed of the α-phase and β-phase of zirconium enriched niobium. The phase state of the loaded specimens strongly depends on the loading conditions and the layer depth. In the case of low-intense loading, the alloys have a two-phase structure composed of the α- and ω-phases. The amount of the ω-phase is maximal in the layers near the external surface of the specimens and decreases until it completely disappears as the centre of the ball is approached. In addition to the α- and ω-phases, the traces of the β-phase of zirconium enriched niobium are observed on X-ray diffraction patterns of both alloys. In the case of high-intense loading, the ω-phase disappears in the alloys because of high remaining temperatures. The martensite structure is observed in the area of instable plastic flow near the hollow. X-ray diffraction analysis shows that the alloys in these regions consist of hexagonal α'-phase. The lattice parameters of the α'-phase correspond to those of the α'-phase in these alloys quenched from β-field. This indicates that the conditions required for martensite $\beta \rightarrow \alpha'$ transformation were realized in this case.

It is shown that dislocation structure strongly depends on the layer depth. The α- and ω-phases contain a great amount of dislocations. In addition to dislocations, microtwins are present in subsurface layers of the balls. In contrast to pure zirconium, the formation of coarse twins in the zirconium-niobium alloys is not observed.

s6.m2.p6 Equation of state and phase diagram of $KNbO_3$ up to 30 GPa and from 100 to 500 K. A powder X-ray diffraction study. Ph. Pruzan,[1] D. Gourdain,[1] J.C. Chervin,[1] B. Canny,[1]and M. Hanfland[2]. *[1]Physique des Milieux Condensés, UMR 7602, Université P. et M. Curie, case 77, F-75252 Paris Cedex 05, France. [2]ESRF, BP220, 38043 Grenoble Cedex, France*

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This work is part of a study on ferroelectric perovskites at high pressure. Angle-dispersive powder x-ray diffraction was used to investigate the $KNbO_3$ perovskite to obtain information on the phase diagram and to determine the p,V,T equation of state. Measurements were performed up to 30 GPa and from 100 to 500 K. Experimental details on the x-ray set-up and the ancillary devices can be found elsewhere [1,2]. $KNbO_3$, as $BaTiO_3$, is characterised by the well known phase transformation sequence cubic-tetragonal-orthorhombic-rhombohedral. The stability domains of the three solids determined by x-ray are consistent with our previous Raman determination of the phase diagram [3]. The pressure dependences of the cell parameters were obtained, and the cell volume data were fitted to a Murnaghan equation of state. The temperature dependences of the bulk modulus B_0 and its pressure derivative $B?_0$ were determined from the fit. The p,V,T equation of state may be used to estimate the thermodynamics properties of $KNbO_3$ under pressure.

Comparisons with previous x-ray data at 295 K by energy-dispersive method [4], neutron diffraction data obtained at RAL [5], using the Paris-Edinburgh cell, and with preliminary x-ray results on $BaTiO_3$ will be given.

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