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THE INFLUENCE OF CHEMICAL AND PHASE COMPOSITION ON THE FEATURES OF THE STRUCTURAL STATE AND ON THE SUPERPLASTICITY INDICATORS OF ALUMINUM ALLOYS 1450, 1460, 01420T, AND AMg6

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The article presents the results of studies that summarize data on the superplasticity of multicomponent aluminum alloys 1450, 1460, 01420T, and AMg6. The influence of the chemical and phase composition of alloys on the features of the structural state of their samples and on the indicators of their superplasticity, which occurs during their deformation in air, in the creep mode at high homologous temperatures, has been analyzed.

INTRODUCTION

It is known that when creating aluminum alloys that belong to the class of deformation alloys, the set of alloying elements is selected in such a way that it makes it possible to provide the required level of their plasticity and strength indicators. The ability of multicomponent aluminum alloys to exhibit structural superplasticity in the solid state or in the solid-liquid state places special requirements on their chemical and phase composition and structural state [1–4].

Among all the requirements relating to the structural state of superplastic aluminum alloys and composite materials based on them, the most important is the requirement for the presence in their samples, which are deformed at high homologous temperatures, of an ultrafine grain structure stable to coarsening. It has been established that aluminum alloys doped with zirconium and scandium have exactly such structure [1–3, 5–8]. They were created in the second half and at the end of the 20th century and are still used today both for scientific research on the topic of superplasticity, and in industrial technologies for processing alloys and composite materials by pressure, based on superplastic forming. Currently, research is also being conducted on the properties of aluminum alloys, which, in addition to zirconium or scandium, are additionally microalloyed with erbium, ytterbium, and hafnium [9–11]. Since the main contribution to superplastic deformation is made by grain boundary sliding [1–4], for its implementation, the active development of deformation and accommodation processes in grains and at their boundaries is also important. It has been revealed that accommodation processes take place differently in samples which are in solid or solid-liquid state during superplastic deformation [1–4].

The purpose of the research, the results of which are presented in this article, is to summarize data on the superplasticity of aluminum alloys 1450, 1460, 01420T, and AMg6, as well as to establish the influence of their chemical and phase composition on the features of the structural state and superplasticity indicators.

1. MATERIAL AND EXPERIMENTAL

Samples for mechanical testing and structural studies were made from industrial semi-finished products of such multi-component aluminum alloys: 1450 (base Al – 2.64% Cu – 2.2% Li – 0.12% Zr, wt.%), 1460 (base Al – 2.64% Cu – 2.2% Li – 0.12% Zr – 0.12% Sc, wt.%), 01420T (base Al – 5.0…6.0% Mg, 1.9…2.3% Li, 0.09…0.15% Zr, 0.1…0.3% Si, ≤ 0.3% Fe, 0.1% Ti, 0.3% Mn, 0.005% Na, wt.%), and AMg6 (base Al – 5.8…6.8% Mg – 0.5…0.8% Mn – 0.02…0.10% Ti, 0.0002…0.005% Be – 0.4% Fe – 0.4% Si, wt.%) [5–8]. They had a working part length 10 mm and a cross-section area of which was 3.0×5.0 mm. Mechanical tests of samples of the studied alloys were performed in the air in the creep mode under the constant applied flow stress.

To conduct the structural studies, the surface of the working part of the samples was ground and mechanically polished. Final polishing of the sample surface was performed using diamond paste with a grain size of 1/0. Marker lines were applied to the polished surface of the samples using diamond paste 10/7. A chemical etchant was used to detect grain boundaries in samples of the studied aluminum alloys. It has the following composition: 17 ml HNO_3, 5 ml HF, 78 ml H_2O.

Structural studies were performed using a MIM6 light microscope equipped with a Micro Scan digital camera and JEOL JSM-840 and Tescan VEGA 3 LMH scanning electron microscopes. This microscope is equipped with a Bruker XFlash 5010 energy dispersive X-ray microanalysis devise.

Average grain size $\overline{d}$ in the working parts of the samples was determined from microphotographs of the microstructure. Calculations of $\overline{d}$ was performed using the secant method [12].

2. RESULTS AND DISCUSSION

As a result of mechanical tests of samples of the studied alloys, performed in air in the creep mode under constant applied stress, a complex of metallographic, X-ray, X-ray spectral and fractographic studies, as well as analysis of phase diagrams of the corresponding systems, it was established that samples of alloys 1450 and 1460 exhibited SP in the solid state [13–17], and samples of alloys 01420T and AMg6 – in the solid-liquid state, which was formed due to their partial melting during superplastic deformation at high homologous temperatures [18–23]. Generalized data on the optimal conditions of the superplastic deformation of the studied alloys and on the indicators of their superplasticity are given in Table.

Generalized data on the optimal conditions of the superplastic deformation of the studied alloys and on the indicators of their superplasticity

Alloy grade	Optimal test temperature T, K	Optimal flow stress σ, MPa	True strain rate $\dot{\varepsilon}$, s^{-1}	Relative elongation to failure δ, %
1450	773	3.5	$3.5 \cdot 10^{-4}$	650
1460	793	3.5	$3.3 \cdot 10^{-4}$	1000
01420T	793	4.5	$5.8 \cdot 10^{-5}$	670
AMg6	813	4.5	$1.3 \cdot 10^{-4}$	235

Let us consider the characteristics of the microstructure of samples of alloys 1450 and 1460 and the features of its changes during superplastic deformation.

It was found that the initial microstructure of sheet industrial semi-finished products of alloy 1450 samples in the as-delivered state is non-recrystallized and heterogeneous (Fig. 1,a). The grains contain a large number of clusters consisting of particles of intermetallic phases. They are located both in the grain body and at their boundaries. Since the recrystallization annealing of alloy 1450 samples, performed in air at different temperatures and heating rates, did not lead to the formation of a homogeneous ultrafine-grained structure due to the development of static recrystallization in them, it was formed directly during the superplastic deformation of alloy 1450 samples due to the implementation of continuous dynamic recrystallization. It was found that the microstructure with an average grain size $\overline{d}$ = 3…6 μm was formed in samples that were superplastically deformed in the creep mode under the optimal conditions to degrees of conditional relative deformation ε_{cond}, which achieve 20…50% (Fig. 1,b). During the subsequent stages of superplastic flow, the average grain size $\overline{d}$ in samples of alloy 1450 increases. It was found that in samples of alloy 1450, which were deformed to failure under the optimal conditions, the vast majority of grains retain their equiaxed shape, and their average size $\overline{d}$ is 10…15 μm (Fig. 1,c). Some of the grains are elongated in the tensile direction, which may indicate both the development of intragranular dislocation slip during superplastic deformation and the growth and coarsening of these grains due to collective dynamic recrystallization occurring in the sample. In superplastically deformed samples of alloy 1450, grain boundary cavities and cracks nucleate and grow during flow.

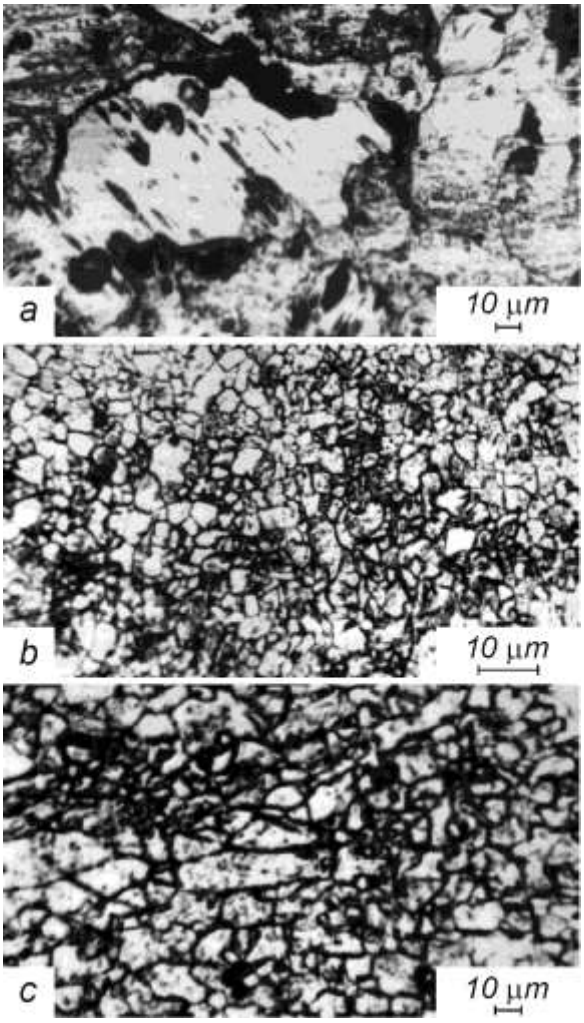

Fig. 1. Typical views of microstructure of the working part of samples of alloy 1450: a – in the delivery state; b – deformed to ε_{cond} = 50%; c – deformed to failure to 650%. In b and c the tensile stress direction of the samples is horizontal

A characteristic view of the initial grain structure of alloy 1460 samples is shown in Fig. 2,a. Ultrafine grain structure with medium grain size $\overline{d}$ = 5 μm in sheet semi-finished products of alloy 1460 was formed as a result of their thermomechanical treatment performed under industrial conditions during manufacture.

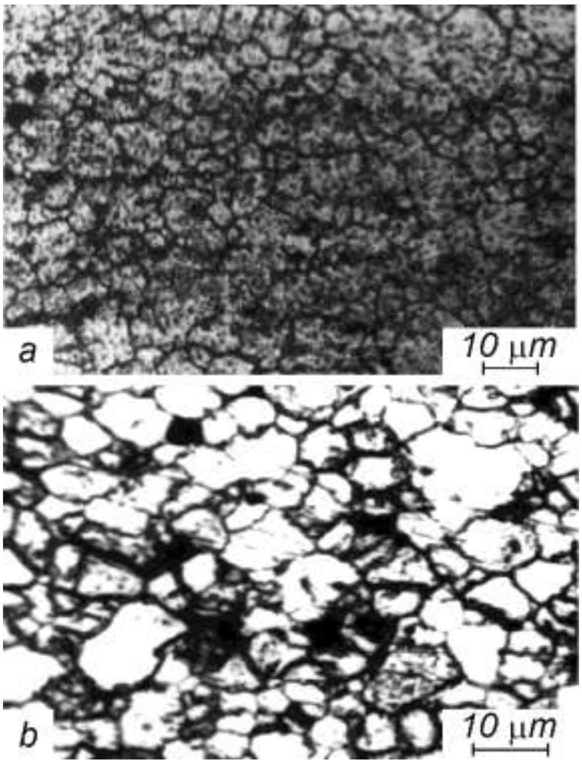

Fig. 2. Typical views of microstructure of the working part of alloy 1460 samples: a – in the delivery state; b – deformed in optimal conditions of the superplasticity to failure to 1000%. In b the tensile stress direction of the sample is horizontal

During the superplastic deformation of alloy 1460 samples, the average grain size $\overline{d}$ in the samples increases and to the moment of their failure is approximately equal to 15 μm.

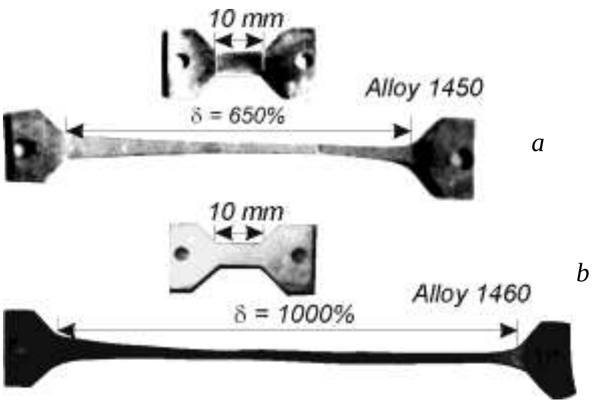

Fig. 3. Samples of alloys 1450 (a) and 1460 (b), superplastically deformed to failure under the conditions that are optimal for their superplasticity, compared with the original, undeformed ones

According to the results of mechanical tests, it was found that the relative elongation of alloy 1460 samples which were superplastically deformed under optimal superplastic conditions to failure is greater than that of alloy 1450 samples that were also superplastically deformed to failure under optimal superplastic conditions (see Table). The general view of these samples is shown in Fig. 3. It can be seen that at the macroscopic level their superplastic deformation occurs homogeneously without noticeable localization of deformation.

Alloys 1450 and 1460 contain the same amount of copper, magnesium, and zirconium, but alloy 1460 also contains scandium in addition to zirconium. It is known from the literature that zirconium and scandium, which are present in a solid solution based on aluminum, provide grinding of its grains, which are formed in the ingot during the crystallization of multicomponent aluminum alloys. And fine dispersed particles of zirconium and scandium aluminides Al_3Zr and Al_3Sc, coherent with Al, are the effective stabilizers of the microstructure in aluminum alloys at high temperatures [1–3, 6–8]. These particles are isomorphic to the matrix – an aluminum-based solid solution α_{Al} since their crystal lattice parameter differs very little from the lattice parameter of the matrix – an aluminum-based solid solution, by only 1.24% [5]. It is likely that the presence of a small amount of zirconium and scandium in alloy 1460 ensures the formation of a sufficient number of fine particles Al_3Zr, A_3Sc, and $Al_3(Sc_xZr_{1-X})$ in its microstructure. Their presence contributes to the formation of ultrafine grains in samples during dynamic recrystallization and is able to ensure thermal stability of the grain structure of samples during their superplastic deformation, which occurs at high homologous temperatures, due to the fact that they are an effective obstacle to the movement of high-angle grain boundaries during their migration [1–3, 6–8, 16, 17].

A characteristic view of the initial grain structure of alloy 01420T is presented in Fig. 4,a. It can be seen the grain structure of this alloy is bimodal [18–22].

The vast majority of grains in the working part of the initial samples of alloy 01420T, made from an industrial semi-finished product, are ultrafine. Their average size $\overline{d}$ is approximately equal to 5 μm. In certain areas of the working part of the samples prepared for mechanical testing, large elongated grains are concentrated, the average size of which is approximately 20 μm. These grains are limited by low-angle boundaries. It can be predicted that in alloy 01420T zirconium and zirconium aluminide Al_3Zr play an important role in forming the grain structure of this alloy during the crystallization of its ingots during the manufacturing process and restraining grain growth during recrystallization and superplastic deformation at high homologous temperatures.

Fig. 5 shows a general view of alloy 01420T sample, superplastically deformed to failure under optimal superplastic conditions. It can be seen that its superplastic deformation, like the superplastic deformation of alloys 1450 and 1460 samples, was homogeneous at the macroscopic level and occurred with high stability. It ensured a large elongation of this sample before failure, which occurred without the neck formation.

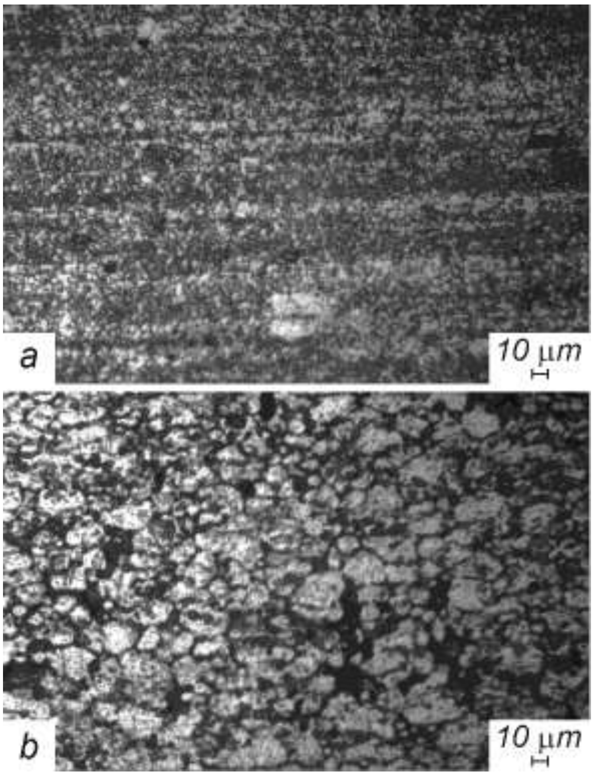

Fig. 4. Characteristic view of the initial microstructure of the working part of the 01420T alloy sample (a) and the microstructure of the sample of the same alloy deformed to failure to 670% in optimal superplastic conditions (b). The strain direction of the sample is horizontal

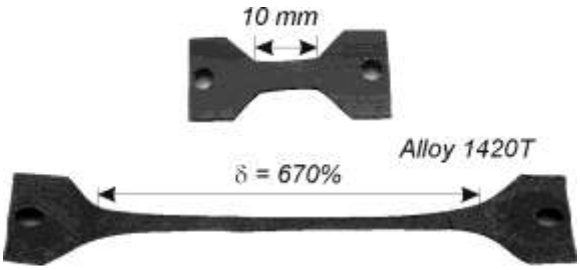

Fig. 5. A sample of alloy 01420T, superplastically deformed to failure under the optimal conditions for the manifestation of superplasticity, compared to the original, undeformed one

By conducting studies of the microstructure of alloy 01420T samples, superplastically deformed to failure under optimal superplastic conditions, it was established that the vast majority of grains in the working part of samples deformed to significant degrees of conditional deformation and failure are ultrafine (see Fig. 4,b). Their average size $\overline{d}$ is approximately equal to 10 μm. However, in some of its areas there is a small number of large polygonised grains elongated along the tensile stress direction of the samples. Their average size $\overline{d}$ is approximately equal to 25 μm. These grains sometimes border with ultrafine grains, the average size $\overline{d}$ of which is approximately equal to 5 μm. Grain boundary cavities and cracks are present in superplastically deformed samples of alloy 01420T. Fibrous formations were found in some of the cavities and cracks (Fig. 6).

Metallographic studies have shown that the grain structure of the working part of the AMg6 alloy samples is ultrafine-grained and equiaxed (Fig. 7) [23, 24]. Average grain size $\overline{d}$ = 7 μm.

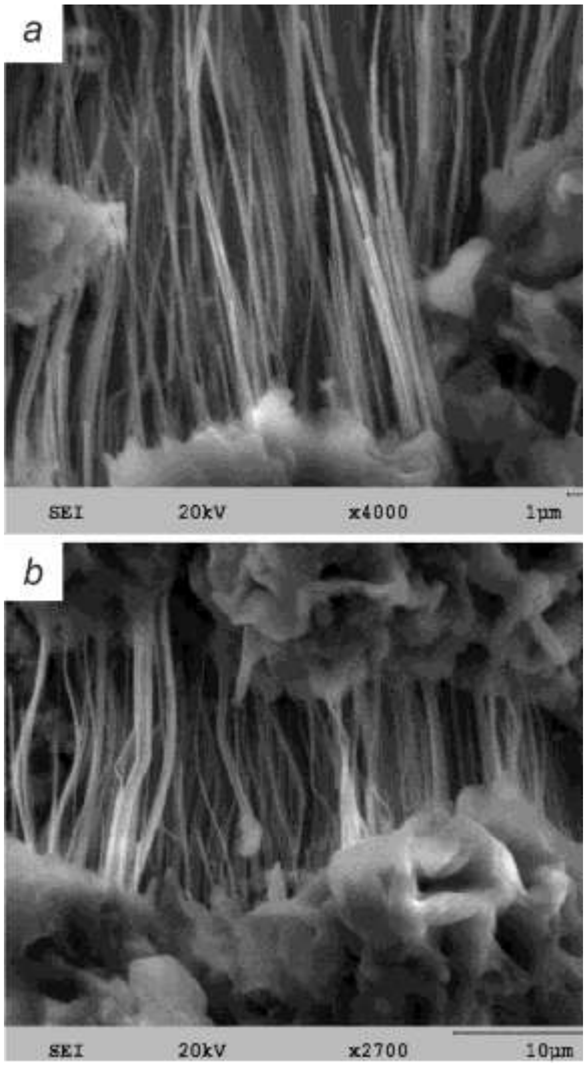

Fig. 6. Characteristic types of fibrous structures in the working part of samples of alloy 01420T, deformed to failure under the optimal conditions of the superplasticity. Scanning electron microscopy. The strain direction is vertical

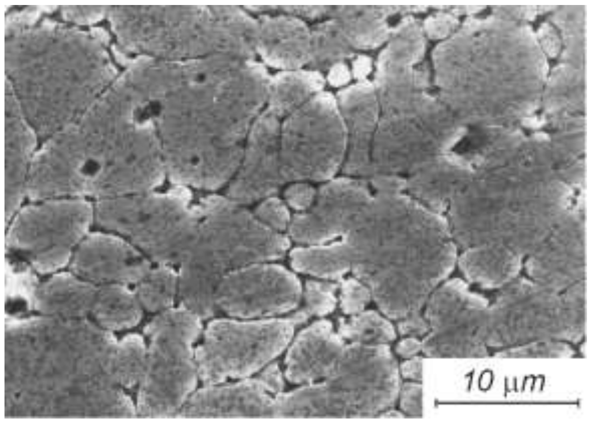

Fig. 7. A characteristic view of the microstructure in the working part of the AMg6 alloy sample prepared for testing

At the grain boundaries of an aluminum-based solid solution α_{Al} and in their body there are clusters of intermetallic particles. It is likely that among these particles there are also finely dispersed particles of the $MnAl_6$ phase, which ensure the thermal stability of the grains of this alloy at high homologous temperatures [8].

It was found that during the superplastic deformation the average grain size in the working part of the AMg6 alloy samples increases. In a sample deformed to failure at $T = 813$ K, σ = 4.5 MPa and $\dot{\varepsilon} = 1.3 \cdot 10^{-3}\mathrm{s}^{-1}$ the average grain size is approximately 22 μm.

Samples of the AMg6 alloy showed the best indicators of superplasticity at 813 K, σ = 4.5 MPa. Their relative elongation to failure δ = 235% which is less than that of alloys 1450, 1460, and 011420T. The presence of coarse layers consisting of intermetallic particles containing magnesium at the grain boundaries of AMg6 alloy samples leads to the formation and development of grain boundary cavities. Their combination into magistral cracks is the cause of premature failure of the samples [23, 24]. Fig. 8,a shows a characteristic view of the deformation relief formed on the previously polished surface of the working part of the AMg6 alloy sample as a result of the grain boundary sliding during its SPD at $T = 813$ K, σ = 4.5 MPa and $\dot{\varepsilon} = 1.3 \cdot 10^{-3}\mathrm{s}^{-1}$.

The deformation relief of the working part of the AMg6 alloy (see Fig. 8,a) reveals individual rounded grains, which have a fringe in the form of small thin fibers at the edges. This view of grains may be due to the fact that the samples of the AMg6 alloy at the test temperature $T = 813$ K were probably in a solid-liquid state. The boundary layers of grains could be undermelted. Because of this, they could change their relief as a result of the processes of grain melting, dissolution of intermetallic particles, and diffusion with the participation of the liquid phase, as well as undergo viscous deformation during superplastic deformation. Fibrous structures were also detected in the deformation relief formed on the superplastically deformed working parts of the AMg6 alloy samples. In cavities and cracks, they are located mainly parallel to the tensile direction of the samples (see Fig. 8).

The main alloying elements in alloy 01420T are magnesium and lithium. The AMg6 alloy also contains magnesium [5, 10, 11]. Since the superplastic deformation of samples of both these alloys takes place at high homologous temperatures, under these conditions melting of a certain number of those local areas of grains and intergranular boundaries that consist of a solid solution based on aluminum α_{Al} containing high concentrations of lithium and magnesium may occur. As is known [4, 8, 21] these elements lower the melting point of the aluminum-based solid solution, which is the main phase of both alloys. It was found that in samples of alloys 01420T and AMg6, the cells of the viscous liquid phase, which formed as a result of partial melting, are concentrated in individual triple grain junctions, as well as at some intergranular and interphase boundaries. Their viscous flow during the superplastic deformation of the samples leads to the formation of fibrous structures, which are indirect evidence that the alloys 01420T and AMg6 exhibited superplasticity in the solid-liquid state, which was formed as a result of partial melting of these alloys.

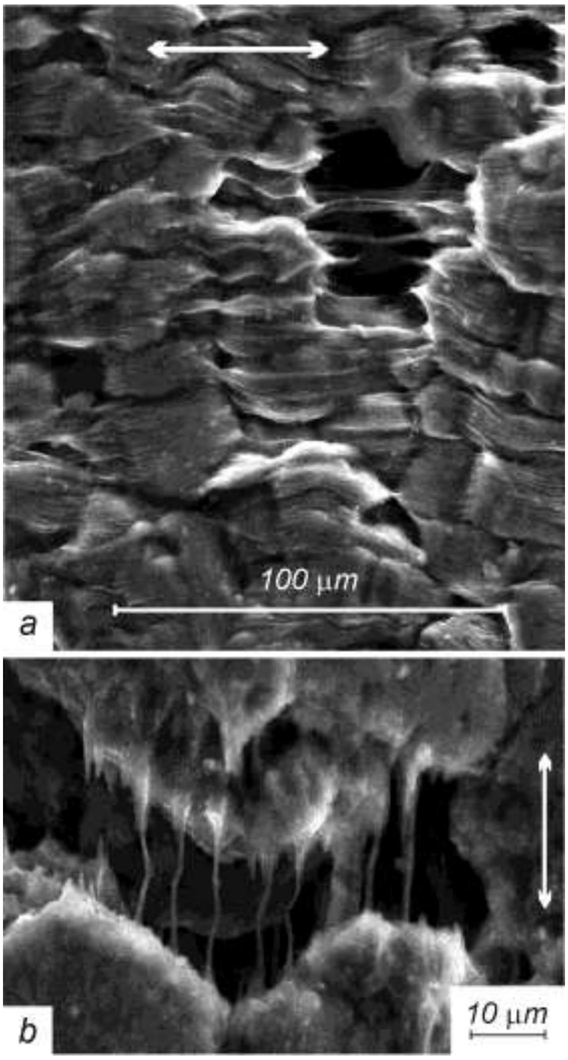

Fig. 8. Characteristic types of deformation relief (a) and fibrous structures (b) in the working part of AMg6 alloy samples deformed to failure under optimal SP conditions. Scanning electron microscopy

The fibers, as can be seen from Figs. 6 and 8, look like “solidified” streams of viscous liquid. The morphology of the fibers found in the working part of superplastically deformed samples of alloys 01420T and AMg6 is similar to the morphology of those fibers observed by the authors of works [25–29], who studied the high-temperature superplasticity of various aluminum alloys obtained by casting ingots and composite materials in which the multicomponent aluminum alloy is the matrix. The reasons for partial melting and the mechanisms of formation of fibrous structures in samples of alloys 01420T and AMg6 and other studied aluminum alloys were considered in our works [29–31].

CONCLUSIONS

1. Data on the superplasticity of industrial multicomponent aluminum alloys 1450, 1460, 01420T, AMg6, which was exhibited by their samples deformed

in air in the creep mode at a constant applied flow stress and high homologous temperatures, are summarized.

2. The microstructure of alloys 1450, 1460, 01420T, AMg6 and its change during superplastic deformation were investigated. It is confirmed that zirconium, which is an alloying component of alloys 1450, 1460, 01420T, and scandium, which is additionally alloyed to alloy 1460, ensure the formation of an ultrafine grain structure in samples of these alloys, and dispersed particles of zirconium and scandium aluminides present in the working parts of the samples effectively counteract grain growth during superplastic deformation, which occurs in air at high homologous temperatures.

3. In samples of alloys 01420T and AMg6, superplastically deformed at high homologous temperatures, fibrous structures were found that formed and developed during the superplastic deformation due to the viscous flow of the viscous liquid phase formed due to partial melting of the alloys.

REFERENCES

1. *Superplastic Forming of Structural Alloys* / Ed. by N. Paton, K. Hamilton: Transl. from English. M.: "Metallurgy", 1985, 218 p.

2. K.A. Padmanabhan, S. Balasivanandha Prabu, R.R. Mulyukov, Ayrat Nazarov, R.M. Imayev, S. Ghosh Chowdhury. *Superplasticity: Common Basis for a Near-Ubiquitous Phenomenon*. Springer, Verlag, Berlin, Heidelberg. 2018, 526 p.; https://doi.org/10.1007/978-3-642-31957-0

3. Xiao-guo Wang, Qiu-shu Li, Rui-rui Wu, Xiao-yuan Zhang, Liyun Ma. A Review on Superplastic Formation Behavior of Al Alloys *// Advances in Materials Science and Engineering*. 2018, Article ID 7606140, p. 1-17; https://doi.org/10.1155/2018/7606140

4. M. Mabuchi, H.G. Jeong, K. Hiraga, K. Higashi. Partial melting at interfaces and grain boundaries for high-strain-rate superplastic materials // *Interface Sci.* 1996, v. 4, N 3-4, p. 357-368.

5. I.N. Friedlander, K.V. Chuistov, A.L. Berezina, N.I. Kolobnev. *Aluminum-lithium alloys. Structure and properties*. Kyiv: "Naukova Dumka", 1992, 192 p.

6. S.T. Alieva, M.B. Altman, S.M. Ambartsumyan, et al. *Industrial aluminum alloys:* Reference ed. M.: "Metallurgy", 1984, 528 p.

7. I.N. Friedlander. Constructional aluminum-lithium alloys // *Metallovedeniye i termicheskaya obrabotka metallov*. 1989, N 4 , p. 2-8 (in Russian).

8. A.M. Zakharov. *Industrial non-ferrous metal alloys. Phase composition and structural components*. M.: "Metallurgy", 1980, 256 p.

9. S.P. Wen, Z.B. Xing, H. Huang, B.L. Li, W. Wang, Z.R. Nie. The effect of erbium on the microstructure and mechanical properties of Al-Mg-Mn-Zr alloy // *Mater. Sci. Eng. A.* 2009, v. 516 (1-2), p. 42-49;. https://doi.org/10.1016/j.msea.2009.02.045

10. Yuntao Li, Zhiyi Liu, Qingkun Xia and Yanbin Liu. Grain Refinement of the Al-Cu-Mg-Ag Alloy with Er and Sc Additions *// Metall. Mater. Trans.* 2007, A 38, p. 2853-2858; https://doi.org/10.1007/s11661-007-9269-4

11. Guosheng Peng, Kanghua Chen, Huachan Fang, Songyi Chen. A study of nanoscale Al_3(Zr,Yb) dispersoids structure and thermal stability in Al-Zr-Yb alloy // *Materials Science and Engineering A.* 2012, v. 535, p. 311-315; https://doi.org/10.1016/j.msea.2011.12.094

12. S.A. Saltykov. *Stereometric metallography*. M.: "Metallurgy", 1980, 272 p.

13. V.P. Poyda, V.V. Bryukhovetskiy, A.V. Poyda, R.I. Kuznetsova, V.F. Klepikov. Superplasticity of aluminum-lithium alloy 1460 in the field of high homological temperatures // *Metallofizika i noveyshiye tekhnologii.* 2002, v. 24, N 10, p. 1397-1411 (in Russian).

14. A.V. Poyda, V.V. Bryukhovetskiy, V.P. Poyda, R.I. Kuznetsova, V.F. Klepikov, T.B. Lyubitskaya, A.P. Kryshtal'. High-temperature structural super-plasticity of the 1450 alloy of the Al-Cu-Li-Zr system // *Vistnik of KhNU, Physics series.* 2006, v. 9, N 739, p. 85-89.

15. A.V. Poyda, V.V. Bryukhovetskiy, R.I. Kuznetsova, V.F. Klepikov, D.L. Voronov, T.B. Lyubitskaya. Structural changes during high-temperature superplastic deformation of aluminum-lithium alloy 1460 *// Physics of Metals and Metal Science.* 2005, v. 99, N 2, p. 105-111.

16. V.P. Poyda, A.V. Poyda. Formation of grain structure and its change during superplastic deformation of samples of alloys Al-4.1 wt.% Cu-0.5 wt.% Zr, 1450 and 1460, doped with zirconium and scandium // *Vistnik of KhNU, Physics series,* 2022, v. 36, p. 14-24; https://doi.org/10.26565/2222-5617-2022-36-02

17. A.V. Poyda, V.P. Poyda. Superplastic deformation of aluminum-lithium alloys 1450 and 1460, alloyed with zirconium and scandium // *Problems of Atomic Science and Technology.* 2024, N 1(149), p. 71-76; https://doi.org/10.46813/2024-149-071

18. V.P. Poyda, A.V. Poyda, V.V. Bryukhovets′kyy, R.I. Kuznyetsova, O.P. Kryshtal′, O.L. Samsonyk, D.Ye. Pedun, Kafarani Ali Makhmud. High-temperature structural superplasticity of aluminum-lithium alloy 01420T // *Vistnik of KhNU, Physics series.* 2010, N 914, v. 13, p. 86-91.

19. D.E. Milaya, V.P. Poyda, V.V. Bryukhovetskiy, A.V. Poyda. Superplasticity of alloy 01420T with the initial bimodal grain structure // *Vistnik of KhNU, Physics series.* 2016, v. 29, p. 29-34.

20. D.E. Mila, V.P. Poyda, V.V. Bryukhovetskiy, A.V. Poyda. Superplastic deformation of the 01420T alloy with an initial bimodal grain structure // *Metallofizika i noveyshiye tekhnologii*. 2020, v. 42, N 4, p. 511-529 (in Russian).

21. V.P. Poyda, D.E. Milaya, A.V. Poyda, V.V. Bryukhovetsky, R.V. Sukhov. The influence of magnesium on phase transformations and structural changes occurring during superplastic deformation of 01420T alloy // *Problems of Atomic Science and Technology*. 2014, N 4(92), p. 139-146.

22. V.P. Poyda, A.V. Poyda, D.E. Mila. The influence of the main alloying elements on the formation of the initial grain structure, on phase transformations and on structural changes that occur during superplastic deformation of alloys Al–4.1 wt.%

Mg-0.5 wt.% Zr, 1420T, 1421, 1423 // *Journal of V.N. Karazin Kharkiv National University, Series "Physics"*. 2022, v. 37, p. 30-38; https://doi.org/10.26565/2222-5617-2022-37-03

23. A.V. Poyda, V.V. Bryukhovetsky, D.L. Voronov, R.I. Kuznetsova, V.F. Klepikov. Superplastic behavior of AMg6 alloy at high homologous temperatures // *Metallofizika i noveyshiye tekhnologii*. 2005, v. 27, N 3, p. 319-333 (in Russian).

24. A.V. Poyda. Structural changes and mechanisms of superplastic deformation in AMg6 alloy samples at high homologous temperatures // *Vistnik of KhNU, Physics series*. 2008, v. 11, N 821, p. 49-58.

25. C.L. Chen, M.J. Tan. Cavity growth and filament formation of superplastically deformed Al 7475 Alloy // *Materials Science and Engineering*. 2001, A298, p. 235-244; https://doi.org/10.1016/S0928-4931(00)00193-4

26. C.L. Chen, M.J. Tan. Effect of grain boundary character distribution (GBCD) on the cavitation behavior during superplastic deformation of Al 7475 // *Materials Science and Engineering*. 2002, A338, p. 243-252.

27. W.D. Cao, X.P. Lu, and H. Conrad. Whisker Formation and the Mechanism of Superplastic Deformation // *Acta Mater*. 1996, v. 44(2), p. 697-706; https://doi.org/10.1016/1359-6454(95)00176-X

28. Jung-Kuei Chang, Eric M. Taleff, Paul E. Krajewski, James R. Ciulik. Effects of atmosphere in filament formation on a superplastically deformed aluminum-magnesium alloy // *Scripta Materialia*. 2009, v. 60, issue 6, p. 459-462; https://doi.org/10.1016/j.scriptamat.2008.11.031

29. V.P. Poyda, V.V. Bryukhovetskiy, R.I. Kuznetsova, A.V. Poyda, V.F. Klepikov. Formation and development of fibrous structures during superplastic deformation of matrix aluminum alloys // *Metallofizika i noveyshiye tekhnologii*. 2003, v. 25, N 1, p. 117-132 (in Russian).

30. V.P. Poyda, V.V. Bryukhovetsky, A.V. Poyda, R.I. Kuznetsova, V.F. Klepikov, D.L. Voronov. Morphology and mechanisms of formation of fibrous formations under conditions of high-temperature superplastic deformation of aluminum alloys // *Physics of Metals and Metal Science*. 2007, v. 103, N 4, p. 433-444; https://doi.org/10.1134/S0031918X07040151

31. A.V. Poyda, V.P. Poyda, V.V. Bryukhovetskiy, R.I. Kuznetsova. The mechanism of development of fibrous formations during superplastic deformation of structural aluminum alloys // *Metallofizika i noveyshiye tekhnologii*. 2008, v. 30, special issue, p. 301-313 (in Russian).

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ВПЛИВ ХІМІЧНОГО І ФАЗОВОГО СКЛАДУ НА ОСОБЛИВОСТІ СТРУКТУРНОГО СТАНУ ТА НА ПОКАЗНИКИ НАДПЛАСТИЧНОСТІ АЛЮМІНІЄВИХ СПЛАВІВ 1450, 1460, 01420Т і АМг6

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Викладено результати досліджень, які узагальнюють дані про надпластичність багатокомпонентних алюмінієвих сплавів 1450, 1460, 01420Т і АМг6. Проаналізовано вплив хімічного і фазового складу сплавів на особливості структурного стану їх зразків та на показники їх надпластичності, яка проявляється при їх деформуванні на повітрі, в режимі повзучості при високих гомологічних температурах.