

KINETICS OF INTERACTION OF OXYGEN WITH THE WATER ABSORPTIVE COMPOUND TiAl

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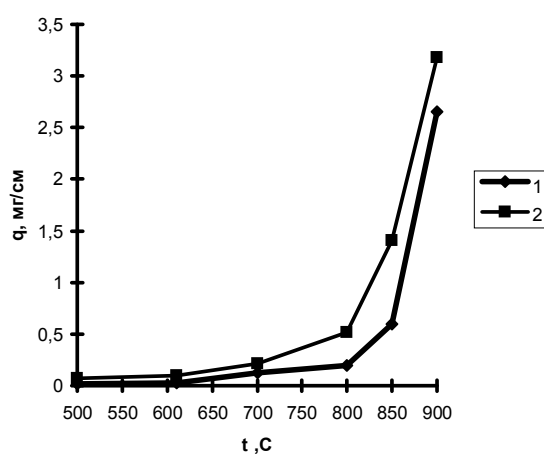
Interaction of the intermetallic compound TiAl with oxygen was studied in the interval 500-900°C with the application of gravimetric methods. The alloy was melted in arc furnace in the atmosphere of argon and homogenized at 1000°C during 70 hours. The oxidability $q = \Delta P / S$ was determined, where ΔP is a weight addition in mg and S is an initial area of the sample in cm². At low temperatures and initial stages the process interaction process was carried in the kinetic regime, is controlled by the processes of oxygen-building and approximated by the linear temporal equation. Parabolic oxidation occurs after the formation of the compact oxygen layer ($t \geq 600^\circ\text{C}$) and described by the formula $q^2 = K_p \tau$, where K_p is a coefficient of the rate of the parabolic oxidation.

The specific characteristic of the parabolic oxidation is a periodical increase K_p (700-800°C) or its decrease (850-900°C). The first data is an evidence of the detachment of the scale and the second one indicates its braking.

The interaction of the compound TiAl with oxygen is rather feeble at low temperatures. Hence, after the six hours' of the oxidation under 500°C $q = 0,01 \text{ mg/cm}^2$, and under 600°C the valuation of the oxidability doesn't exceed $0,07 \text{ mg/cm}^2$. With rising of the temperature from 800 °C to 900 °C q rises steeply (figure). The same is observed in the case of the oxidation of the compound TiAl.

Of a great interest for us was the comparison of the oxidability of TiAl with the oxidability of another hydrogenation compounds, such as TiFe[2], ZrNi[3] and TiNi[1]. In the table 2 the relation of the oxidability of TiFe (q_1), ZrNi (q_2) and TiNi (q_3) with the oxidability of TiAl is represented. In all the cases q_3 of TiNi is appeared to be higher than q of TiAl in 2-3 times, and q_3/q_1 doesn't depend visibly on the regimes of the oxidation, that can prove the fact that the mechanisms of interaction of the oxygen with the compounds TiNi and TiAl are the same.

The oxidability of TiFe and ZrNi differ considerably more in comparison with TiAl. Moreover q_1/q similarly to q_2/q depend on the regimes of the oxidation (table 2). It is the result of diversity in the kinetic of the oxidation of asTiFe[2], ZrNi[3] and TiAl.



The dependence of the oxidability q , mg/cm^2 on temperature (t °C): after 2(1) and 6(2) hours of the oxidation

Table 1

t, °C	K_1	K_2
700	0,07	0,18
800	0,06	0,15
850	0,46	0,28
900	3,2	0,75

Table 2

τ , час	q_1/q	q_2/q	q_3/q
700 °C			
2	22,4	41,6	2,32
4	23,5	40,0	2,94
6	21,4	35,7	3,19
800 °C			
2	34,0	21,0	0,20
4	33,9	20,7	3,8
6	23,0	11,9	2,8
850 °C			
2	16,6	6,3	2,3
4	15,9	4,4	2,0
6	15,2	4,0	2,0
900 °C			
2	9,7	2,19	1,8
4	10,6	2,3	2,4
6	12,3	2,5	2,9

Conclusions

1. The compound TiAl interacts feebly with the oxygen at low temperatures.
2. In the series of hydrogenation compounds as TiFe, ZrNi, TiN and TiAl the last one (TiAl) resists the oxidation the most.

References

1. Chuprina V.G. Study of the Titanium Nickelide Oxidation Process. I. Kinetics. Powder Metallurgy, 1989, №4, 75-80.
2. Chuprina V.G, Shalya I.M., Zenkov V.S, TiFe hydrogen-absorbing intermetallic interaction with oxygen. II. TiFe oxidation kinetics. Powder metallurgy, 1995, № 9-10, 64-67.
3. Chuprina V.G, Shalya I.M. Oxidation processes of the alloys in the Ni-Zr system. III. Oxidation of NiZr. Powder metallurgy, 2004, № 9-10, 77-86.