VISCOSITIES OF LIQUID Pd–Si BASED ALLOYS①

Guo, Wenquan Wang, Jingtang

State Key Lab of Rapidly Solidified Non-Equilibrium Alloys, Institute of Metal Research, Academia Sinica, Shenyang 110015, China

ABSTRACT

The viscosities of liquid Pd81Si19, Pd84Si16 and Pd78Cu6Si16 are measured with the oscillating-vessel method. The results are compared with those in literatures.

Key words: Pd–Si based alloys liquid viscosity Oscillating-vessel method

1 INTRODUCTION

Pd–Si based alloys are early used to explore glass formation and its properties. Little was learnt about their physical characteristics in liquid. The viscosity of liquid alloys is the critical factor to govern the glass-forming tendency. In the article, we present the results of the viscosities of liquid Pd–Si based alloys.

2. SAMPLE PREPARATION AND EXPERIMENT

The samples of Pd–Si based alloys are prepared with Pd, Cu and Si, 99.99 wt–% in purity, by the use of vaccum arc melting. The compositions of them are analysed with chemical method. The viscosities of liquid Pd81Si19, Pd84Si16 and Pd78Cu6Si16 are measured with oscillating-vessel method, and the logarithmic decrement is

$$\lambda = \{\ln(\varphi_0 / \varphi_N) + \ln(\varphi_1 / \varphi_{N+1}) + \cdots + \ln(\varphi_n / \varphi_{N+n})\} / [N(n+1)] \quad (1)$$

where $N = 20$, $n = 9$, φ–amplitude. The working formula[1] is

$$(\lambda - \lambda_f) / \rho = A(\eta / \rho)^{1/2} - B(\eta / \rho) + C(\eta / \rho)^{3/2} \quad (2)$$

where A, B and C are the constants concerning the viscometer. The value of ρ, the density of liquid alloy, was quoted from ref. [2].

3 RESULTS AND DISCUSSION

The curves in Fig. 1 can be expressed as follows

for Pd81Si19:

$\lg\eta = 2{,}314 / T - 3.530$ (1,123 ~ 1,323 K)

for Pd84Si16:

$\lg\eta = 1{,}462 / T - 2.650$ (1,073 ~ 1,273 K)

for Pd78Cu6Si16:

$\lg\eta = 1{,}709 / T - 2.770$ (1,073 ~ 1,323 K)

Fig. 2 shows the present results and those in refs. [3–8]. Masumoto *et al* reported remarkably different results[4–5]. With the same method as the present and different working formulae, Steinberg *et al* obtained larger results[6–7]. Furthermore, they directly used the logarithmic decrement of empty crucible, neglected the performance of liquid alloys. The

①Manuscript received April 25, 1992

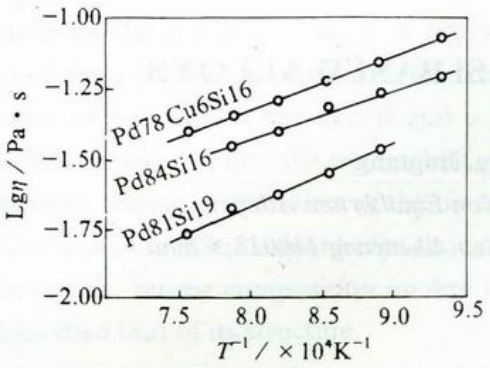

Fig. 1 The curves of logη vs 1 / T

results of extrapolating viscous flow of amorphous[3] is remarkably high. In order to get reliable viscosity,the authors explored theoretically and experimentally, and corrected Roscoe's absolute viscosity formulae[1]. So our results are reliable and accurate.

4 CONCLUSIONS

The viscosities for liquid Pd–Si based alloys are as follows.

for Pd81Si19:

$$\lg\eta = 2{,}314 / T - 3.530 \quad (1{,}123 \sim 1{,}323\ \mathrm{K})$$

for Pd84Si16:

$$\lg\eta = 1{,}462 / T - 2.650 \quad (1{,}073 \sim 1{,}273\ \mathrm{K})$$

for Pd78Cu6Si16:

$$\lg\eta = 1{,}907 / T - 2.770 \quad (1{,}073 \sim 1{,}323\ \mathrm{K})$$

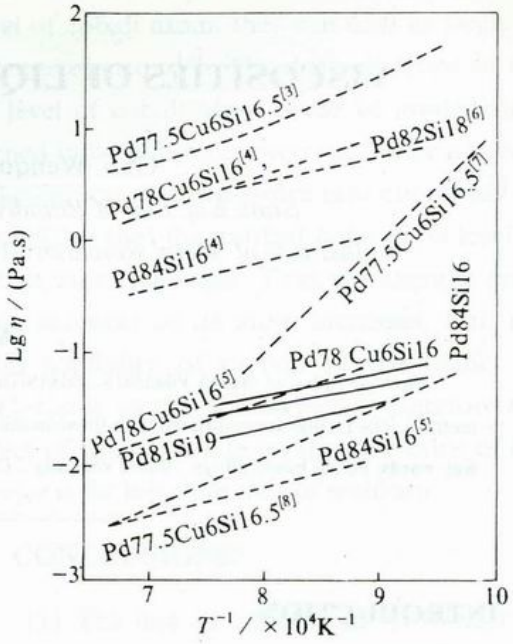

Fig. 2 The comparison of the experimental results with those in ref. s [3–8]

REFERENCES

1 Guo, Wenguan *et al.* Acta Metallurgica Sinica, 1992, 28: A160.
2 Guo, Wenguan. Ph D Thesis, 1992.
3 Chen, H. S. *et al.* J Appl Phys, 1972, 43: 1642.
4 Naka, M. *et al.* In: Cantor B. ed., Proc 3rd Int Conf On Rapidly Quenched Metals, 1978, I: 231.
5 Nishi, Y. *et al.* J Japan Inst Metals, 1980, 44: 1336.
6 Steinberg, J. *et al.* Acta Metall, 1981, 29: 1309.
7 Steinberg, J. *et al.* Appl Phys Letter, 1981, 36: 878.
8 Davies, H. A. *et al.* Scripta Metall, 1974, 8: 1179.