ABOUT TEMPERATURE DEPENDENCE OF MELTED LITHIUM HYDRIDE VISCOSITY

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Lithium hydride (LiH) is a chemical compound with a high thermal capacity [1] which can be used as an evaporating heat-shielding covering for space vehicles [2]. Hydrodynamic calculations of flows in boundary layers demand the information on temperature dependence of melted LiH viscosity which is studied insufficiently in detail. Results of measurement of melted LiH viscosity has been received by two groups of researchers [3] (in a range 690–1050°C) and [4, 5] (in a range 678–859°C). The specified experimental data is strongly separated among themselves. For example, at temperature nearby 800°C double divergences of viscosity from works [3] and [4, 5] are observed.

We calculate dynamic viscosity of melted LiH by a method of pseudo-atom molecular dynamics (PAMD) [6, 7] in a range of temperatures from 670 to 1100°C. Calculations by PAMD method are economic and do not demand of any additional data, except data about substance structure, its temperature and density. Temperature dependences of melted LiH density has been taken from work [1].

Series of calculations with a variation of base time step, total number of particles in system, and also density of liquid LiH are spent for research of stability of mathematical modelling results. In particular, auxiliary calculations of melted LiH equilibrium density at the minimum of Helmholtz free energy are executed. All results of computer modelling are mutually agree within the statistical uncertainty of PAMD calculations. Besides, reliability of results of modelling of LiH viscosity indirectly proves to be true the consent of theoretical viscosity for pure liquid lithium at temperature from 320 to 1200°C with the experimental data taken from the hand-book [8].

Results of calculations in comparison with experimental data [3] and [4, 5] are presented in figure 1. From figure 1 follows, that in the considered range of temperature viscosity of melted LiH is closely fits with results of work [4, 5], but is not agree with results of [3]. The exact chemical compound of samples from work [3] is not known [1] to us. Therefore results of experiment [3] are possible to explain by pollution of an investigated material by impurity of heavier atoms than Li. However the account of an impurity of sodium (from 2.5 to 20% at. from the initial part of lithium) has not resulted in essential shift of calculated viscosity towards experimental data [3] whereas the best consent with data [4, 5] is noted just for composition Li0.475Na0.025H0.5. Thus, distinctions of results of PAMD-calculations and experiment [3] are caused by presence yet not revealed systematic experimental error. Detailed experimental and theoretical researches of melted LiH viscosity should be continued.

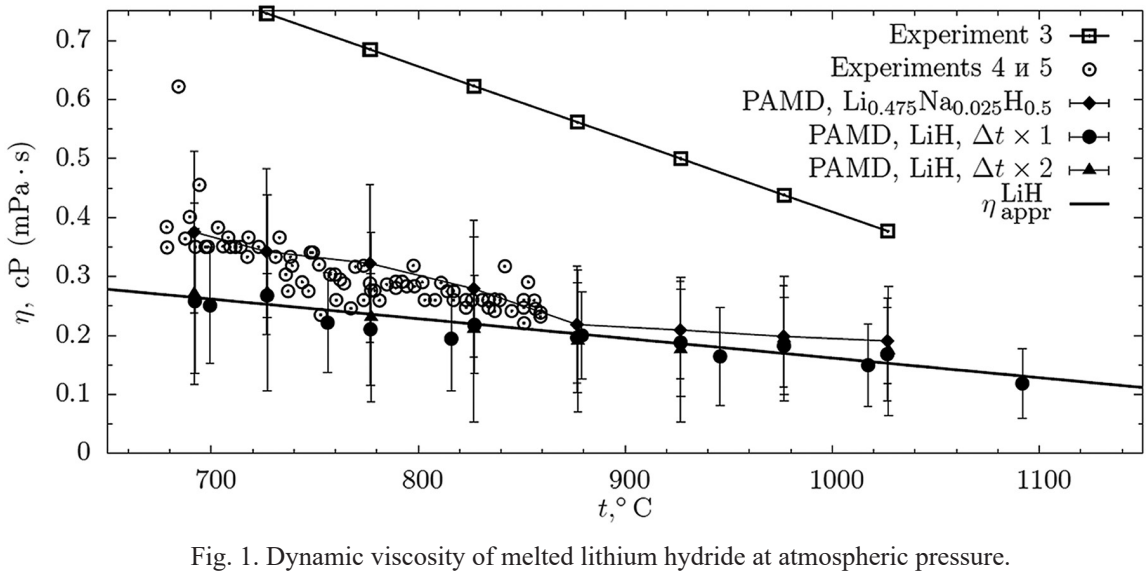

Fig. 1. Dynamic viscosity of melted lithium hydride at atmospheric pressure.
Comparison of results of PAMD modeling with experimental data [3, 4, 5]

Results of PAMD modeling can be approximated by analytical dependence which conveniently use engineering calculations:

$$\eta_{annr}^{LiH}\,[\text{mPa}\cdot\text{s}] = 0.495 \pm 0.023 - (3.33 \pm 0.27)\cdot 10^{-4} t,\ 670 < t < 1100°\text{C}.$$

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