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Thermogravimetry and the Negative Temperature Dependence of Gravity

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Introduction

It is shown that data of thermo gravimetric measurements confirm the negative temperature dependence of gravity. The accounting of this dependence is necessary for increase of accuracy of the thermo gravimetric analysis.

The thermogravimetric analysis based on exact weighing of the heated sample is widely applied in researches of physical and chemical properties of materials [1-3]. The first stage of thermo gravimetric measurements is receiving a basic curve – temperature dependence of weight of the empty holder of a sample, for example, of a crucible. At data processing of temperature measurements the basic curve is subtracted from experimental temperature dependence of weight. Out of areas of change of phase structure of substance in which there are sharp changes of its weight, the main reason for the monotonous increasing temperature dependence of weight is considered action of forces of buoyancy. Meanwhile, physical temperature dependence of weight of bodies [4-6] has essential impact on measurements of weight and has to be taken into account in the exact thermogravimetric analysis; this circumstance was noted by Grumazescu [7]. At creation of a basic curve the seeming mass M of the holder (crucible) in air is equal $M=m-\rho V$, where m-the mass of a crucible, V-its volume and ρ-air density. Temperature change of the seeming weight

$$\frac{dM}{dt}=\frac{dM}{dt}-\rho\frac{dV}{dt}-V\frac{d\rho}{dt}, \tag{1}$$

Where $V=V_0(1+\beta t)$, β-volume expansion coefficient of material of a crucible. Temperature dependence of $\rho(t)$ is represented by known expression

$$\rho(t)=\frac{A}{1+Bt}\cdot\frac{p}{760}, \tag{2}$$

Where $A=0.0012932\ \mathrm{g/cm^3}$, $B = 0.00367\ \mathrm{K^{-1}}$, p - air pressure in mm Hg [8]. By normal ($p=760$) air pressure Eq. 1 may be represent as

$$\frac{dM}{dt}=\frac{dm}{dt}+C_1+C_2, \tag{3}$$

Where $C_{1=}\ -V_0\beta A(1+\beta t)^{-1}$, and $C_{2=}\ V_0(1+\beta t)AB$

For numerical estimates we will use results of work [2] according to which the seeming change of mass of a porcelain crucible with the weight $m=4$ g and volume 1.5 $\mathrm{cm^3}$ measured on Shevenar's thermo scales in the temperatures range 200-1000°C is equal $4.0.10^{-6}\ \mathrm{gK^{-1}}$. Volume coefficient of expansion of porcelain $\beta=9.10^{-6}\ \mathrm{K^{-1}}$ [8] and, for example, at t=200°C, the values of coefficients $C_{1.2}$ are equal $C_1= -1.0.10^{-8}\ \mathrm{gK^{-1}}$ and $C_2= 7.1.10^{-6}\ \mathrm{gK^{-1}}$.

As the absolute values $C_1 \prec\prec C_2$, the main contribution to the seeming change of mass of a crucible is made by the effects of buoyancy described by coefficient C_2. Obviously, the consent of the experimental and provided settlement data is possible only at $\frac{dm}{dt}=-3.1.10^{-6}\ \mathrm{gK^{-1}}$. This fact directly confirms established in [4-6] negative temperature dependence of weight of bodies. Temperature change of weight of the holder, it is generally connected with change of temperature of a porcelain crucible, the assessment of size of relative temperature change of the weight of porcelain from where follows the $\gamma=\frac{dm}{mdt}\approx-0.8.10^{-6}\mathrm{K}^{-1}$. Sign and an order of the specified size correspond to data of measurements of physical temperature dependence of weight of various metals [4-6], and also PZT [9]. For more exact quantitative estimates of influence of temperature dependence of weight on results of thermogravimetric measurements, the accounting of the sizes, forms, masses, physical and thermodynamic characteristics as holder, and the studied sample is necessary [8,9]. Temperature dependence of physical weight of bodies will allow to establish the reasons of anomalies of thermogravimetric dependences with bigger degree of reliability and to increase the accuracy of the gravimetric analysis.

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