An experiment discovery about gravitational force changes in materials due to temperature variation

Fan Liangzao[1], Feng Jinsong[2], Liu Wuqing[3]

(1. Chinese Academy of Sciences, Beijing 100094, China; 2. High-tech Research Institute of Chongqing Xinda Group, Fengdu, Chongqing 408200, China; 3. Chongqing TongJunGe Joint-stock Company, Chongqing 400012, China)

Abstract: The authors discovered in first time that the weight of materials or its gravitational force by earth related to its temperature and its ferromagnetism. An experiment was designed to elevate the temperatures of six different materials (Au, Ag, Cu, Fe, Al, Ni) up to 600 ℃ and precisely measured their weights. It is found all the materials weigh about 0.33 ‰ ~ 0.82 ‰ less. For example the weight of silver sample weighted by a precision electronic scale in a manner of special design decreases about 0.8 ‰, when its temperature is elevated to 600 ℃. Thus different metals' gravitational forces or weights are adjusted with temperature variation.

Key words: metal; gravitational force; internal energy of mass; ferromagnetic materials; NdFeB

1 Introduction

It is believed that any object falling down in vacuum will experience the same gravitational acceleration. Still the related researches have been going on for a long time. The 2007 Nobel Prize in physics on the giant magneto-resistance raised a question to be answered, whether there is any properties change in ferromagnetic materials under external magnetic fields except resistance vary.

In an experiment conducted by Mr. Liu Wuqing, it was found that the measured weight of two pieces of NdFeB increase when they are in manner of the mutual attraction instead of repulsion. When two pieces of such materials are splited by hands, we ask where the work done by us has gone. Fan Liangzhao suggested that the work increased the internal energy of two piece of material. To verify his hypothesis, Feng Jinsong and Fan Liangzao designed an experiment to elevate the temperature of different materials to increase their internal energy and then weigh them.

2 Experimental design

The authors elevated the temperature of six different materials (Au, Ag, Cu, Fe, Al, Ni) up to 600 ℃. All are scheduled to be measured by Chongqing Academy of Metrology and Quality Inspection for convenes in public. One might ask if it is true, as well known, the buoyancy force will increase to make slight less weight due to the volume expansion when the temperature increases. At the same time, the hot-air flow surrounding the hot material also intends to reduce its weight.

Received 8 *December* 2009

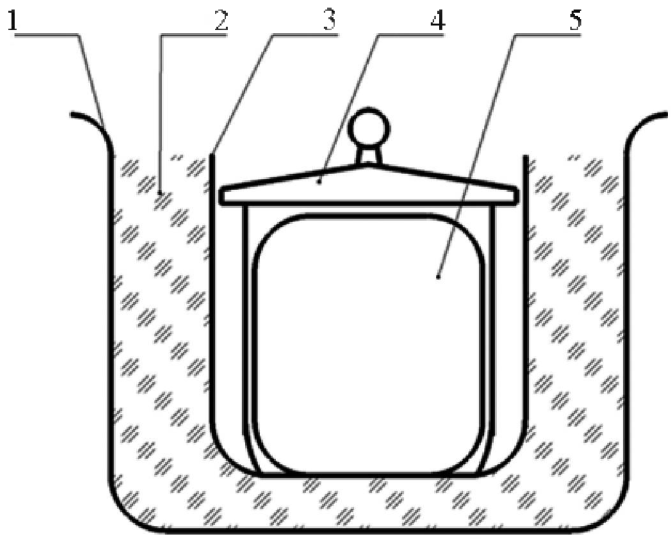
Take the gold sample as an example with the mass m_{Au} of 53.728 2 mg, the volume expansion coefficient β is 42.6×10^{-6}/℃. Let V_0 be its volume at 100 ℃ (for moisture eliminate) and ΔT its elevated temperature minus 100 ℃. Then the volume expansion $\Delta V = V_0 \beta \Delta T$ and the weight change due to buoyancy force ΔF. $\Delta F = V_0 \beta \Delta T \rho_{air} = m_{Au} \beta \Delta T \rho_{air} / \rho_{Au}$, where ρ_{Au} = 19.3 mg/cc, ρ_{air} = 0.002 93 mg/cc. If ΔT = 500 ℃, then $\Delta F \approx 2 \times 10^{-4}$ g = 0.2 mg. It is shown that ΔF is 10^{-2} order small than 17.8 mg (Table 1) which can be neglected.

3 The experimental method and process

3.1 The equipment

To avoid the weight reduction due to the buoyancy force and hot-air flow, the hot material is put into a ceramic crucible, and between ceramic crucible and glass scale cup there are a lot of asbestos filled in. As temperature of ceramic crucible elevated, in a very short time the heat cannot be transmitted into glass scale cup from ceramic crucible. So there is no volume expansion to the holder (Fig. 1).

The volume of the heated material and internal volume of the ceramic crucible are almost the same for guaranteeing air amount contained in it is small. As



1—Glass scale cup; 2—Asbestos;
3—Thin metallic cup; 4—Ceramic crucible;
5—Heated sample

Fig. 1 Diagram of holder

the ceramic crucible sealed by its cover prevents the air contained in it outside, there is no up air flow in the ceramic crucible to reduce its weight.

3.2 Process of weighting

At first the authors weight the material in room temperature named it W_1. It might have a small amount of moisture adhesive to it. Thus W_1 is only a reference value. W_2 is weight of holder without heated material. It is also possible that there is some moisture contained in it. W_3 is the holder with the heated sample which is to be put into the heated stove of 100 ℃ before and stays inside for 30 minutes. The heated sample must be taken off quickly from the ceramic crucible. Then weight the total holder without heated material named W_4. At the same time put the hot material to the stove to elevate its temperature to 200 ℃ and stays inside for 30 minutes.

Before weighting each time, the electron scale must reset to zero. Besides, the W_3 weighting must be performed quickly. In 10 sec time interval, the read value on the election scale has been reached to equilibrium. Thus there is not enough time to elevate the temperature of cold ceramic crucible.

Following the same process, the experiments are performed 6 times when temperature of the stove is elevated from 100, 200, 300, 400, 500, 600 ℃ sequentially, and stays inside for 30 minutes each time. The data in 100 ℃ is taken as the start point for the reason of avoiding moisture addition to the sample. Then the weight of material is equal to $W_3 - W_4$ at a different temperature.

4 Result analysis

Table 1 shows the data of six kind materials weighted from 100 ℃ to 600 ℃, all of these data can be easily repeated by anyone of interest. So the conclusion that the weight or gravitational force of material will decreases due to its temperature increase is true without any doubt. The gravitational force is not only proportional to the mass, inversely proportional to the square of distance, but also affected by the temperature (hot material weighs less). In the future, one might take this adjustment when designing the trajectory of aero-space travelling.

Table 1 The data of weight less due to temperature elevated

Sample		Temperature					
		100 ℃	200 ℃	300 ℃	400 ℃	500 ℃	600 ℃
Au	Weight /g	53.728 2	53.721 3	53.720 3	53.718 5	53.714 4	53.710 4
	Weight less /g		0.006 9	0.007 9	0.009 7	0.013 8	0.017 8
	Weight less ratio /‰		0.128 4	0.147 0	0.180 5	0.266 8	0.331 9
Ag	Weight /g	43.048 1	43.030 2	43.020 5	43.018 6	43.017 5	43.012 8
	Weight less /g		0.017 9	0.027 6	0.029 5	0.030 6	0.035 3
	Weight less ratio /‰		0.415 8	0.641 1	0.685 3	0.710 8	0.820 0
Cu	Weight /g	85.196 7	85.191 3	85.183 2	85.175 0	85.163 8	85.151 8
	Weight less /g		0.005 4	0.013 5	0.021 7	0.032 9	0.044 9
	Weight less ratio /‰		0.063 4	0.158 5	0.254 7	0.386 2	0.527 0
Fe	Weight /g	38.630 5	38.626 6	38.624 1	38.617 7	38.612 9	38.608 4
	Weight less /g		0.003 9	0.006 4	0.012 8	0.017 6	0.022 1
	Weight less ratio /‰		0.100 9	0.165 7	0.331 3	0.455 6	0.572 1
Ni	Weight /g	45.750 0	45.742 7	45.739 9	45.730 6	45.723 7	45.720 7
	Weight less /g		0.007 3	0.010 1	0.019 4	0.026 3	0.029 3
	Weight less ratio /‰		0.159 6	0.220 8	0.424 0	0.574 9	0.640 4
Al	Weight /g	64.088 2	64.081 4	64.065 9	64.059 4	64.050 3	64.045 1
	Weight less /g		0.006 8	0.022 3	0.028 8	0.037 9	0.043 1
	Weight less ratio /‰		0.106 1	0.348 0	0.449 4	0.591 4	0.672 5

An iron sample of 38.638 29 g is first heated up to 600 ℃ and weighed using an electron scale. In order to detect the weight change due to the hot air up flow surrounding the hot material, then the cover of ceramic crucible is taken off and the measurement is repeated every 10 sec. The data in Table 2 and Table 3 show that the material weight loss is less than 1 mg extracted from each 10 sec measurement. It is also a small amount. When a holder like in Fig. 1 is used, there is no volume expansion of the holder and no gas dynamic up flow surrounding the ceramic crucible with cover.

Table 2 The data of weight less due to temperature elevated

Sample	Weight/g (when the temperature is 22 ℃)	Weight /g (elevate its temperature to 600 ℃ and keep the temperature for 30 mintes)
Fe	38.638 29	38.619 40

Table 3 The data of Cu sample weight with different surface due to temperature elevated

Sample	Temperature		
	20 ℃	100 ℃	200 ℃
Cu weight/g (surface 2 199.113 mm^2)	65.324 2	65.175 3	65.172 3
Cu weight/g (surface 4 712.385 mm^2)	64.865 0	64.716 5	64.712 2

To eliminate the possibility that sample surface effect is greater than heating effect, the authors do clearly check experiment using Cu sample with different surfaces (Fig. 2). Table 3 shows the data of Cu simple with different surface weighted from 20 ℃ to 200 ℃. The first group of Cu sample is a circular cylinder, and the second group of Cu sample is five little circular cylinders. The result of the data of weight with

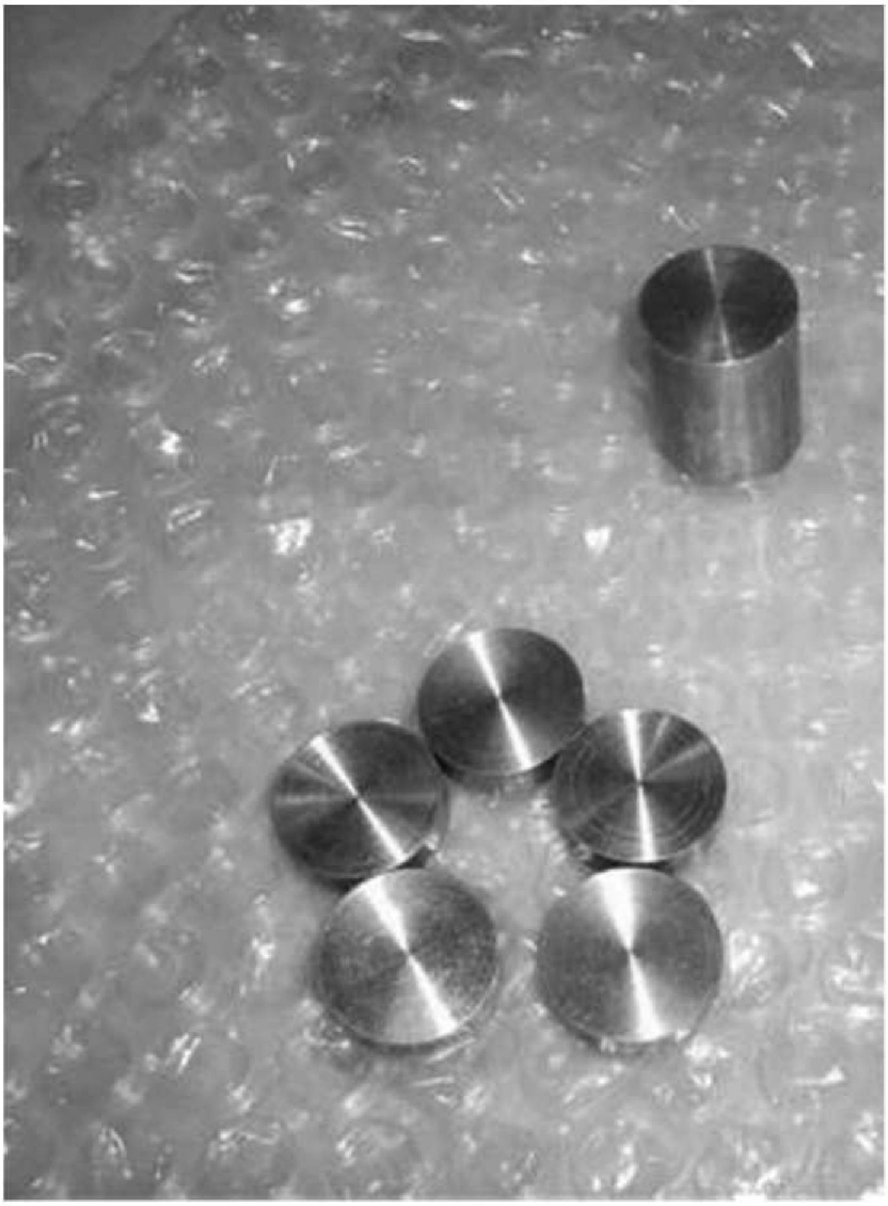


Fig. 2 Cu sample used in the experiment

different surface shows that the affection due to different surface is far less than the affection due to temperature elevation.

The conclusion is that the different metals being heated to 600℃ will weigh about 0. 33 ‰ ~ 0. 82 ‰ less. Although it is difficult to explain the reason behind this using the present existing theory, our first of its kind experimental discovery still is significant and it laid a solid foundation of moving forward.

The 600 ℃ has not reached the melt point of most of the material. When considering melted metal, high temperature plasma (as sun) and high temperature chemistry, it must have the same inference. It will be useful to conduct a research on the origin of gravitational force. We strongly believe that this adjustment to the gravitational force by temperature will open a new area of research in the coming decades.

Author

Fan Liangzao, male, born in 1931, professor of Chinese Academy of Sciences. He graduated from Department of Physics, Peking University in 1955, and then studied in Institute of Mechanics (CAS) from 1957 – 1960. Prof. Fan is an expert in the area of shock-wave dynamics, transducer sciences, and mechanical physics. Recently, his interest changes to the researching of fundamental problem of physics. He can be reached by E-mail: fansiqiong@yahoo.com.cn, or Tel: 13901103870