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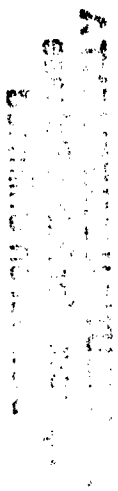

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/Following are translations of articles appearing in Wu-li T'ung-pao (Physics Bulletin), Peiping, No. 5, 1960/

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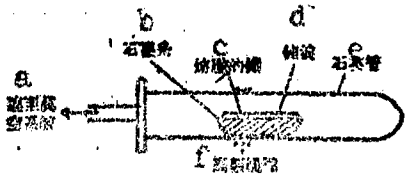
USING A HARD GLASS TUBE IN PLACE OF QUARTZ TUBE IN THE PHYSICAL REFINING OF GERMANIUM

/Following is the translation of an article written by Ch'en Ch'uan-Li of the Physics Department, Nanking University, appearing in Wu-li T'ung-pao (Physics Bulletin) No. 5, Peiping, 1960, page 223./

The general method of physical refining (regional refining) of the semi-conducting material germanium is to put the graphite container of germanium in a transparent quartz tube and process it under high vacuum condition (below 10^{-5} mm mercury) or in inertial gases. The refining process consists of heating germanium and making a narrow melting region on it by a high frequency coil, and then moving the coil by some mechanical means in order to have the narrow melting region move from one end to the other. To repeat this more than ten times super pure germanium can be obtained. (Purity can reach seven 9s to nine 9s). The simple device is shown in fig.1. (If inertial gases are used, then the right end of the quartz tube should have a small hole to let gas flow out).



Key:

a. To Vacuum System
b. Graphite Container
c. Molten Germanium
d. Germanium
e. Quartz Tube
f. High Frequency Coil

Figure 1

A transparent quartz tube is very expensive and under present condition very hard to get. If we do not have quartz tubes, we cannot do the germanium refining and thus production and scientific research qill be adversely affected. To solve the present difficulty of the quartz tube source, some experiments of replacing quartz tubes in the process of germanium refining have been conducted. After many experiments, it is found completely satisfactory. The success of these experiments not only replaces the quartz tube and makes it possible to carry out the work smoothly but also achieves economy.

Water Cooling Type Glass Tube

At first a water-cooling double-layer hard glass tube is designed for the physical refining of germanium. The experimental result shows that when germanium melts, the glass tube can still keep a comparatively low temperature and does not melt. Its construction is shown in fig. 2.

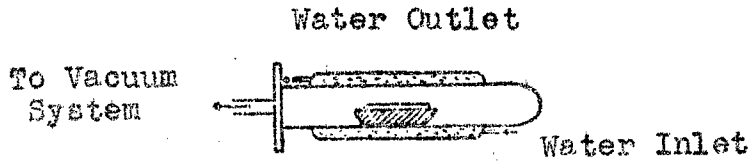


Figure 2.

This type of glass tube satisfies the requirements of refining work, but its effect is not very good. The flowing water carries away the heat and makes a relatively large difference in temperature between inside and outside walls of the tube, the glass tube then can be easily broken, and it is also difficult to increase the temperature of germanium rapidly. Therefore, to keep a proper melting region it is necessary to increase the output power of the high frequency electric inductive stove and to reduce the moving speed of the high frequency working coil. This is not economical in terms of time and also causes trouble in manufacturing and manipulation.

Vacuum Layer Type Glass Tube

To eliminate the above shortcoming, several improvements in construction have been made, and finally, a double layer glass tube subjected directly under high vacuum state without water cooling is designed. Its con-

struction is shown in fig. 3.

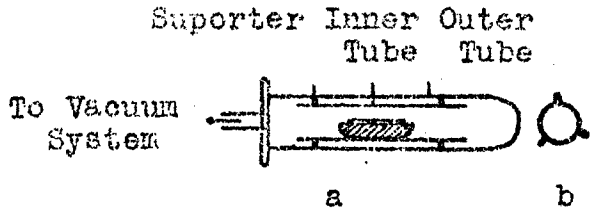


Figure 3.

Inner and outer tubes can be separated, the ends of the inner tube are open, some small supporters on the tube walls are installed (fig.3b). After the tube has been pumped to a high vacuum, the space between the tubes forms a vacuum layer, heat dissipates outwardly in form of radiation, the temperature of the outer tube is greatly decreased. Thus it can keep a sufficient strength to resist the atmospheric pressure.

With the exception of certain features, it is found through several experiments using this type of vacuum layer glass tubes that the effects in germanium refining are satisfactory and comparable with that of a quartz. However, attention must be paid to the following fact. At the place where the graphite container makes direct contact with the inner tube the temperature is very high. In establishing a melting region at one end at the begin-

ning, a certain time interval is required. During this time the inner tube starts to soften and generates a few air bubbles (air absorbed by the glass, although they can be pumped away quickly, they will affect the purity of germanium to certain extent), and the inner tube will bend downward. If the bending is so large that the inner tube contacts the outer tube, then the outer tube might also be softened and be broken by the atmospheric pressure. This is the thing to watch. There are two methods to prevent this [excessive bending]. The first one is to change the position of the inner tube and to make the downward bending upward after the tube has been used for one or two times, and to move the graphite container in order to avoid repeated use at the same place. But this manipulation's relatively inconvenient. The second method is to put many small hard glass tubes under the graphite container (if small quartz tubes or quartz fragments are used, the results are even better), so that it does not have direct contact with the inner tube which will then not bend. The latter method is relatively simple and convenient, and can guarantee that the germanium purity is not affected, (it is especially so if small quartz tubes or quartz fragments are put under the container).

This work has been tested by the semi-conducting

material plant of our school for a long time; results are good. The refined germanium purity reaches eight 9s. Hence, it is positive that hard glass tubes can be used in place of quartz tubes in the physical refining of germanium.

HOW WE UNDERTOOK A TREMENDOUS PROGRAM OF SCIENTIFIC RESEARCH

[Following is the translation of an article by Tsou Kuang-hsing of the Academia Sinica's Kweichow Branch, appearing in Wu-li T'ung-pao (Physics Bulletin), Peiping, No. 5, 1960, page 224-225 and 217.]

In the "Great Leap Forward" of 1959, under the glowing light of the General Line and the leadership of the Party, our institute has vigorously promoted the scientific research program with great success. Before we talk about our scientific endeavour, let me first say a few words about the past and present of our Kweichow province.

Before the liberation, there was a saying in Kweichow: "Weather is never fair for three continuous days, land is never plain within three li and nobody has three fen of silver." These words indeed reflect the living conditions of the people of Kweichow under the exploitation of the Kuomintang reactionaries and the landlord class. At that time, Kweichow did not produce a single chin of steel. An eighteen-year old girl in the village could not even afford to have a pair of trousers to wear. On that kind of economic foundation, scientific research was completely out of question. But everything in Kweichow has changed since the liberation. Industry has developed.

produces
Living conditions have been improved greatly. Kweichow today not only steel but also machinery and heavy equipment. The science undertaking is being rapidly developed. Our Kweichow Institute of the Academia Sinica was established in late 1958 on the foundation of former Kweichow Industrial Comprehensive Research Institute.

Our institute is the product of the "Great Leap Forward". We did not have a solid foundation. But with the help of the people of Kweichow who responded to the call of the party we have grown up amidst difficult conditions.

First, we had met numerous problems since our establishment. Our technical strength was low at the start. We took over about 40 persons from the previous organization. Among them the majority was young and inexperienced. And our newly recruited personnel were mostly college and high school students. We did not have specialists or researchers and so far we have only two college graduates. The rest of our personnel were college sophomores and juniors and high school students. Therefore our technical standard was quite low.

Second, we had serious problem in obtaining equipment. The number of equipment left over from former organization was few. For instance, our testing laboratory has only one metallographic microscope, one all-purpose tester and one material tester. They were called by our comrades as "three treasures" which indeed were treasures to us.

We also lacked books and reference materials. We started to

acquire books after the establishment of our institute. At that time we did not have enough space to stretch out. Books purchased were not cataloged, especially foreign language books. We did not have Chinese and foreign publications and magazines until early 1959. Of course these situations could not satisfy the demand of various units and research projects.

Our housing problem became acute with the expansion of our institute. A small mess hall was converted to living quarters for almost a hundred men. An outdoor grape rack was converted to a rest room.

Under these conditions could scientific research be promoted? Some comrades had said: "With little reference material and little apparatus and without the advice of specialists, our work will not get anywhere." But the staff and workers of our institute exercised their utmost ability and followed the principle of "do whatever can be done under the circumstances" to advance the scientific research. We had met considerable success. Our chemical engineering department had extracted rayon from the corn's stock. Our electrical machinery department has trial constructed the nation's first single phase direct current generator. Our testing laboratory has produced cast iron suitable for making railroad track from the native-made iron. Our chemical engineering, metallurgy and physics departments have jointly completed the task of extracting germanium from lead and zinc ores, etc.

Naturally, we had to put in a lot of effort to achieve these results under the circumstance. Then how did we overcome those difficulties and march forward in the scientific undertaking? For a comprehensive look, let me tell you my personal experience on the refinery of germanium as an example.

Since the start of refinery of germanium in 1958, we had failed many times. But under the leadership of the Party, our germanium refinery team finally succeeded in the production of germanium, from small quantity to large quantity, from trial basis to plant production. Now we have already established the process and at the same time the knowledge and techniques of our technical personnel were raised to a new level.

In this task, the leadership of the Party had a decisive effect on the progress of the project. During each stage , the guidance of the Party played important part in solving many problems. From 1958 to the spring of 1959, we had been trying to extract germanium from yen-tao-hui (smoke-black?). But due to a shortage of raw material, our development was retarded. After the Party organ found out about this, a mass discussion was encouraged to find a new way out. Soon a cooperative effort was organized by the chemical engineering, metallurgy and physics departments. The final decision was the substitution of yen-tao-hui with lead and zinc ores. Thus, the work regained momentum. Because our province has a large deposit of lead and zinc ore, once our process is established we could produce

germanium in large quantity.

How the Party helped us in solving difficulties? Let me give you an example. In late November of 1959, our distillation of chloride was very unstable and the recovery rate was low. Sometimes the distillation did not yield any germanium tetrachloride. Our comrades became pessimistic because time was running out. At that time we had finished only one third of our task for the fourth quarter. Fortunately the Party found out about this and meetings, conferences and discussions were called. Our faith was reestablished with the organization of coordinated effort to march on this front. Under cooperation of our comrades, our key problem was finally solved, and our task was triumphantly fulfilled ten days ahead of schedule. Generally speaking, we all feel that without the guidance of the Party, we could never achieve the result. Therefore the completion of our project was made possible by the leadership of the Party.

The execution of "task carries course" and "do whatever can be done for the scientific research under the circumstance" was the second experience of our success. When we started the refinery of germanium we first set our target and our work was directed toward that end. Once the supply of yen-tao-hui was in question, we naturally set out to find a more abundance raw material. Under the guidance of this kind of thought, we quickly solved the problem of raw material. Another example was the production of ten grams of germanium in ten days as ordered by the Party to participate in an

exhibition in Peiping by our comrades. It was a difficult task but our comrades accepted it without reservation. With hard work and struggling days and nights, we finally completed the task. Not only that, with the progress of the work our tephnique in the refinery of germanium improved.

We also realized that it is important to take the line of the masses. We had only more than ten persons in our team; three college graduates, one high school student and the rest workers. We had only one young engineer. The average age of our team was 20 years and none of us had any experience in the refinery of germanium. With this kind of technical strength, we could not have gotten anywhere. But with mass movements such as "battle for three months", "battle for second quarter", "battle for second quarter accomplishment as a contribution to the July 1st", "battle for third quarter accomplishment as a contribution to our national day" and "battle for fourth quarter accomplishment to let us stop into 1960 ahead of schedule" as urged by the Party, we mobilized our comrades in a mass assault on our problem and resulted in the solving of technical and equipment problems. Our finding which resulted in the substitution of yen-tao-hui with lead and zinc ores was also the result of taking the line of the masses. When the work stopped nobody know how to handle it. We mobilized all of our comrades to check the reference materials thoroughly until we found out that lead and zinc ores contain larger quantity of germanium. Moreover, our province has large output of

these ores. We tested the samples and found them containing germanium in considerable quantity. Our decision was then made to use these ores. But how to do it, none of us was too clear. The process described in the book was a general idea. Therefore we again held numerous discussions which resulted in the adoption of a process similar to the one used to extract germanium from yen-tao-hui. Many technical problems were solved in the same way. In general, our vigorous promotion of mass movement has helped us to overcome technical and equipment difficulties.

The practicing of principles like "consolidation of native and foreign methods" and "walking-on-two-legs" was important to the success of our solving of equipment problem. Our refinery of germanium last year was done by "native things" and "native and foreign" equipment. For instance, we did not have filtering equipment at that time. We used a rice sieve with a filtering paper to do the job. We could not get tannic acid but we extracted it from galls. We used coal furnace instead of electric furnace. We used ordinary iron pot to make concentration of liquid. From the standpoint of our current production we believe that these methods not only simple but also effective and costing less. We believe that if we did not emply these native methods and equipment we could not have produced anything. Therefore we think that the consolidation of native and foreign method and equipment should warrant special attention especially to those units poorly equiped like us. This example should silence those who

thought that scientific research is impossible with "poor equipment".

Finally I would like to say a few words about the hard working spirit of our comrades and their devotion to their tasks. At first they had very little idea about the refinery of germanium. But once the Party pointed out the direction, they are not afraid of anything but go ahead to challenge the difficulties whatever may be. The first time they obtained germanium from yen-tao-hui, they could only see it in the microscope. But that did not discourage them but made them work harder until the victory was won. In our diffusion process our "ch'in-ch'u-lu" was above 85 percent and the man responsible for this technical work was only a high school student. Our working conditions were poor but nobody had complained. We worked hard and worked long hours. Some of our comrades worked in the daytime and returned again in the evening. This is why we could achieve great results in the scientific research even under such a poor working conditions.

We have a deep conviction that if only we could carry out the spirit of the General Line and rally around the Party and vigorously promoting mass movement, we could do a great lot for the scientific research.

In our one year's work, we had gained considerable experience. But we realized that among the national scientific institutions we are comparatively a poor one. Although we had some accomplishments during 1959, we should keep up our vigilance and work for a better achievement in 1960's scientific research program.

The above is my personal opinion. I welcome comment and advice.

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