A Study on ancient Chumbakmani as described in BrihadVimanShashtra

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Abstract

Maharshi Bhardwaj in his book Brihad Viman Shastra has given the recipes for making many instruments. In one chapter he describes an instrument called GuhagarbhaDarshanYantras, which helps to detect any arsenal hidden underground. This instrument has many parts, but this paper we report the results of our efforts to prepare three instruments: Panchloha(sutra No 38-41), Pargrandhik Drav (sutra No 42-46) and Chumbak Mani(sutra No 47-50). It is observed that the instruments work like a photoelectrochemical cell, where solar energy is converted into electrical energy. A flux material developed is very reactive and can dissolve sand, iron and platinum even at 600^{o}C. Chumbak mani which behaves like a magnet shows metallic as well as semiconducting properties. It is concluded that the given in the book for the preparation of these materials are genuine. It is also suggested that there is a need to carry out experiments on all other recipes described in the book to find out their usefulness.

1. Introduction

Swami BrhammuniParivarjak compiled the work of MaharshiBhardwaj and published under the name of BrihadVimanShashtra [1]. This book has 21chapters including description of various types of aeroplanes, types of food the pilot should take. Discussions about the PushpakViman, Smrangsutradhar of MaharajBhoj. It gives reference to YagurVed and Rig Veda. Narayan Muni, Shonik-GargVachaspati, Chhakrayayni, Dhundinatha. They have written scientific books likeVimanchandrika, VyamaYantra, Yantrakalp, Yanbindu, KhetyanPradipika, ByomayaAkarshanPrakash. The purpose of mentioning these books is to suggest there are many scientific books written by our ancient scientists known as Munis and there is a need to study these books to understand developed levels of science those days.

With these objectives it was decided to work on the BrihadVimanShashtra. Since this book has as many as 100 adhikaran and 500 sutras, we decided to work on (Chapter-10) sutras 40-50 dealing with making one instrument named as GuhagarbhaDarshan-Yantras used to find the enemies hidden arsenal while flying the plane over those areas. This unit has three components: Panchloha(sutra No 38-41), PargrandhikDrav (sutra No 42-46) and Chumbak Mani(sutra No 47-50). As per the description, Chumbak Mani is the main component which emits some kind of electrical signals. Pargrandhikdrav is a solution which acts like a redox type of solution. When chumak Mani is dipped into it and exposed to solar rays, produces some electrical power. Panchloha is used to make an ohmic contact with chumnak Mani allowing electrical signals to be send to other instrument to generating some kind of images. We did notwork on theinstrument which generates the images coming out of the chumbak Mani.

The recipes provided in the book for making these parts of instruments were difficult to decipher, because the names exact meanings were not available in Sanskrit dictionary. Nevertheless, by contacting various people we procured the ingredients as well as identified the method of their preparation.

In this paper, results obtained with our efforts on understanding the methodof its preparation, characterization of materials and their possible applications are discussed.

2. Experimental techniques

2.1 Preparation of Chumbak Mani

Chumbak Mani is made by mixing equal amounts(10g each) of the following ingredients, and then firing in the furnace at desired temperature

Fe_3O_4, sand, borax, ivory, pippali, mercury, parvan (mixture of equal amount of K_2CO_3 and KCL) copper, ranjik (shinguraf), sonamakhi, gridhanik, sauri, Buffalo's nail, VishwaKapal (buffalo's head). These materials were washed several times with water and dried at 40^{o}C. These were then grinded in a grinding machine for 24 h. These mixtures were taken in recrystalised alumina crucible and heated in the furnace. Temperature was raised slowly to 1250^{o}C. When on the top of the molten liquid bluish flame type started appearing, the entire material was poured into a flat container and allowed to cool down. It was very necessary to heat the sample till the dancing of blue type flames appear on the top of the liquid in crucible. This is mentioned as *NETRAMILAN*. This temperature was found to be 1250°C.In the original book it mentioned that one has to heat at the rate of 100 degree. Meaning of which we could not understand. Hence we made the material as mentioned earlier. It was also difficult to get a suitable crucible, because the molten mixture was reactive to platinum crucible. It was also difficult to measure the temperature by thermocouple inside the crucible, because that also reacted in the liquid. Hence outer temperature was only measured. However, dancing of blue flame over the surface of the liquid (*NETRAMILAN*) was found to be the best criteria to decide the correct temperature and time for which heating should be done. Finally the liquid was poured into a flat plate for cooling. After cooling two phases were visible and could be separated easily. One part had shining dotes. This part was also magnetic. Other part was non magnetic. About 25% of material was magnetic and this part has been referred in the book as Cumbakmani, because it glows like Mani.

2.2 Preparation PargrandhikDrav

This materials was prepared by taking equal amount (10g each) of the following ingredients: mercury, bamboo's white material present inside the hollow part of the bamboo, jatagrandhik, parvanik tree's bark, dhatura's seed and roheda' tree's bark, These materials were grinded and boiled in distilled water (100ml) for 2h. Itwas filtered. The filtrate was yellowish green. This was very sensitive to light. Hence it was kept in the dark. By exposing it to light, it became dark colored. This liquid is known as pargrandhikdrav.

2.3 Preparation of Panchloha

Panchloha was prepared by taking equal amount (10g each) of the following components: zinc, sonamakhi, copper, dear's horn andVish-Vrajak. These materials were washed with water, dried at 40°C. They ware then grinded for 2h and kept in an alumina crucible. The crucible was heated at 300°C . The entire material became liquid. After heating for 3h it was cooled giving shining metal. This is called as a panchloha.

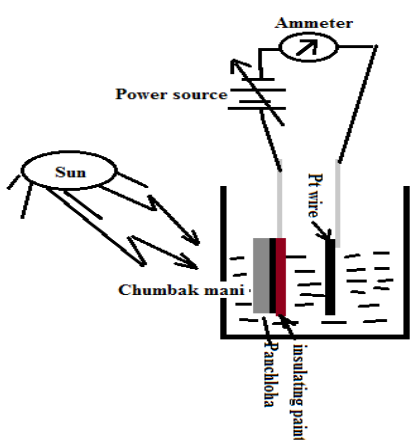
2.4 Assembly of GuhagarbhaDarshanYantra

Chumbak Mani was cut into a shape of 1sqcm size. One side of the Chumbakmani was soldered copper wire with panchloha. This assembly was dipped into a beaker containingdifferent electrolyte as well as pargrandhikdrav. Various other redox electrolytes were triede.g., Fe^{3+}/Fe^{2+} (nitrate, pH 1.0), Ce^{4+}/Ce^{3+} (nitrate, pH 1.0),Ferro/Ferric cyanide (pH 13), KI/I_3 (pH 6.6). Since there was no information about the band position of chumbak Mani, these redox electrolytes were also tried to observe their behavior with chumbakmani. The amount of liquid was enough to cover the chumbakmani. In order that panchloha does not come in contact with liquid; it was painted with an insulating paint. A platinum electrode was used as a counter electrode (Figure 1). Finally chumbakmani was exposed to solar radiation and current and potential were measured with time (Table-1).

Table.1. *d-values obtained from XRD of Chumbakmani*

Material	d-values with percentage		
	100%	75%	50%
Chumbakmani as prepared	2.43	1.77	2.91
Chumbakmani annealed at 900°C for 12h	2.48	-	2.91

Fig.1. *A schematic diagram of electrochemical cell fabricated with chumbakmani. Details of the materials forming the cell are shown in the figure.*



Chumbakmani was characterized by XRD, TGA/DTA, ESR, Spectroscopy study, electrical conductivity,Atomic absorption, and Photoresistivity.

3. Results and discussion

3.1 Analysis of composition of Chumbak Mani

Atomic absorption of chumbakmani was carried out from a solution of known weight of chumbakmani dissolved in known volume of nitric acid.The analysis gave the presence of Cu,Mn, Si and Fe. Their exact concentration was difficult to find out because chumbakmani was not completely soluble in acid. Plate of chumbakmanicwas analysed by XPS which showed the similar results as obtained with atomic absorption analysis. But none of these techniques could give the exact percentage composition because chumbakmani was not completely soluble in acid and we had no standard graph for all the component of the material.

3.2 XRD analysis

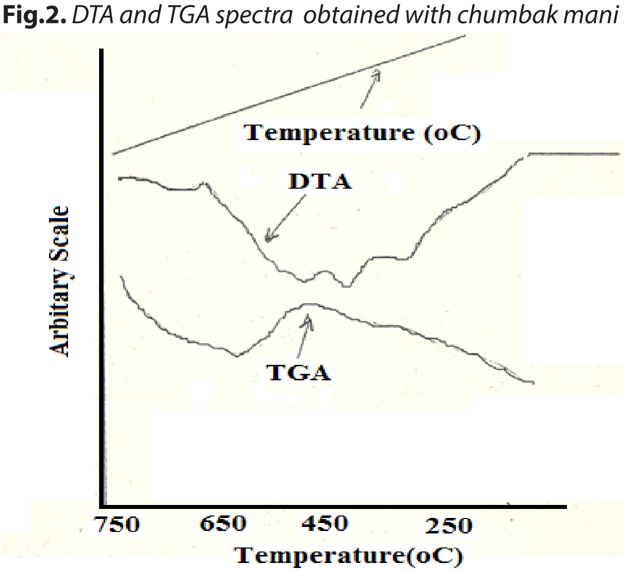
XRD of chumbakmani was taken by using cobalt and iron target. D-values were calculated and shown in table-2. XRD of chumbakmani annealed at 900^{o}C for 24 h was also taken to observe any changes in the d- values. It is observed from the table-2 that there is not much changes in the d-values for 100% and 50% lines. However the 75% peak is absent after the annealing. These peaks did not match with any known oxide or metal materials using the JSPDS data. Hence its structure could not be established.It was observed that the pellet heated at 900^{o}C showed some shining dots of copper.There was no change observed in d-values of Chumbakmani even it was annealed for 600^{o}C or at 1000^{o}C under hydrogen atmosphere. This suggested that chumbakmani consists of material which must be an alloy of Cu,Mn, Si and Fe (composition observed with atomic absorption analysis) which has no effect of thermal treatment either in air or hydrogen.

3.3 TGA/DTA

DTA was done in oxygen atmosphere. Results are shown in figure 2. Thermogramshows the presence of phase transitions at 410^{o}C and 460^{o}C. Since the structure of chumbakmani was not established, it is difficult to identify the phases present at these transitions.

The TGA curve showed a continuous loss in weight fromroom temperature to 700^{o}C, with the exception during the temperature range of 450^{o}C to 650^{o}C, where it shows increase in weight. This must be due to oxidation of the material. Since there was no change observed in XRD when sample was heated to 900^{o}C it is difficult to understand the reasons for losing weight. However, it was observed that heating the material at 900^{o}C, some shining dots of copper appeared.

Fig.2. *DTA and TGA spectra obtained with chumbak mani carried out under oxygen atmosphere.*



3.4 ESR studies

Powder of chumbakmani was used for ESR studiesat 9.5GHz at different temperature range from 77K to 569K. Experimental results show that ESR line width at 77K, 298K, 373K, 474K and 569K are 1600G, 900G,650G, 525G and 485G respectively. The line widths are very large. It may be due to shape anisotropy and spin orbital coupling. Line width decreases with increase in temperature which may be due to the exchange coupling between electrons which suppress the dipolar contribution to the line broadening (figure not shown here). Ignoring the shape dependent corrections and taking the observed resonance field Bo in the Kittel's resonance equation and using the equation-1, the calculated g value and Bo at different temperature are given in table-2.

$$g_{sample} = \frac{(g_{ref} * B_{ref})}{B_{sample}} \quad (1)$$

The reasons for observing large variation in the g-value needs further study. However, the single value of $g_{effective}$ showed that there was no local inhomogeneity in the sample.

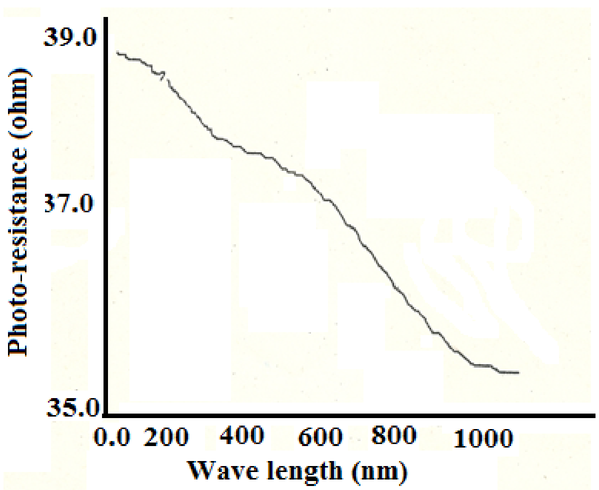
Table 2. *Effect of temperature and magnetic field on the $g_{effective}$ values obtained with chumbakmani*

Temperature (K)	Bo (in G)	$g_{effective}$
77	2400	2.6453
298	2980	2.1304
373	3080	2.0677
473	3140	2.0537
569	3080	2.0547

3.5 Photoresistance at different wavelength

1sqcm plate of chumbakmani was used for this purpose. Two platinum contacts with help of silver paint were made to measure the resistance by a multimeter. This plate was kept in the spectrophotometer such that light falls on the plate of chumbakmani. For every wave length of light falling on the plate the surface resistance was measured. The result of this experiment is shown in figure 3. It is noticed from the graph that as the wave length of light increased surface resistance of the chumbakmani decreased. The result suggests that this material may be useful as light detector.

Fig.3. *Variation in photoresisntance versus the wave length of light used to illuminate chumbak mani.*



3.6 Electrical resistance at various temperatures

1sqcm chumbakmani plate (B) was sandwiched between two platinum plates (A). Each platinum plate was soldered with platinum wire (D). This assembly was kept in quartz tube (C). A thermocouple (E) was also inserted along with platinum wire. This tube was kept in a furnace (G) (figure 4). After keeping the assembly in the furnace, the tube was evacuated to make oxygen free atmosphere.

DC electrical resistance was measured with chumbakmani from room temperature to 750°C with the help of multimeter. Temperature was measured by the Fe/Constant thermocouple. A graph was plotted between the resistance and the temperature (figure 5). It is noticed from the graph that upto temperature380°C resistance was increasing with increase of temperature showing ametallic beahviour of chumbakmani. After 380°C the resistance starts decreasing with increase of temperature showing a semiconducting behavior. This behavior of chumbakmani is strange showing both property : metallic as well as semiconducting behavior. This suggests that this material can be explored to be used as thermo sensor. Since at higher temperature the resistance is decreasing to even zero ohms, it may show some very useful property like superconductivity. A plot of log of conductivity versus 1/T was made and from the slop of two linear part of the linear plot (not shown here) the activation energy for the conduction was calculated. For higher temperature (i..e. for semiconductor behavior) the activation energy was found to be 0.52eV while for the lower temperature region (i.e. for metallic behavior) the activation energy was found to be 0.39eV.

Fig.4. *A schematic sketch of the unit to measure the electrical resistance of the chumbakmani at different temperature. (A) platinum plate, (B) chumbakmani (C) quartz tube (D) Pt wire (E) Thermocouple wire and (F) tube for vacuum pump*

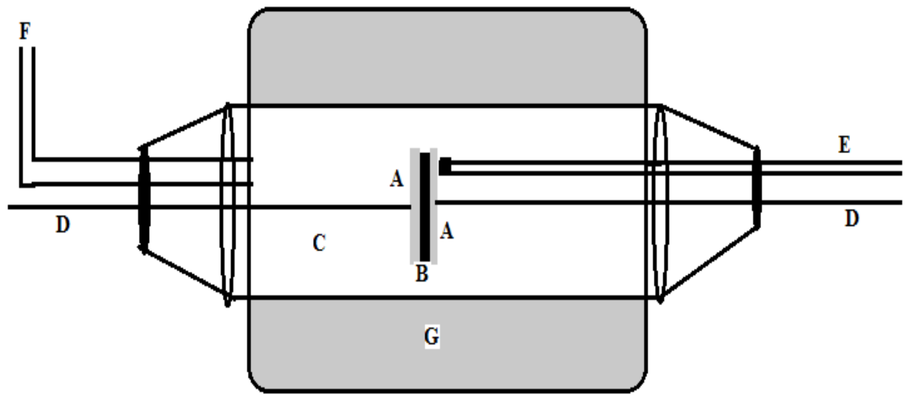
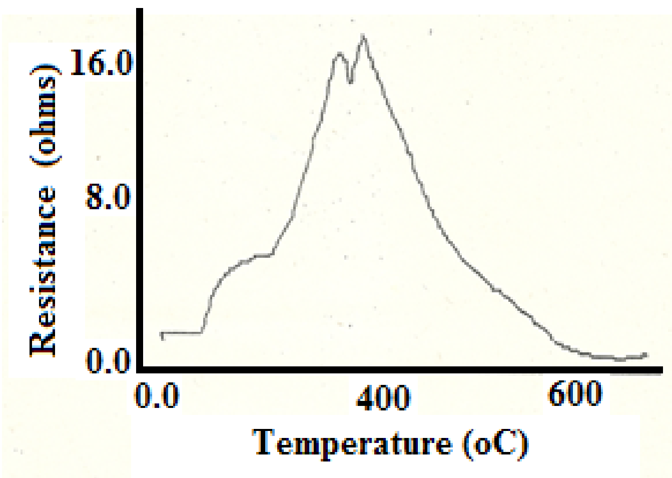


Fig.5. *Variation of resistance of chumbak mani with temperature, showing that up to 400°C if shows metallic beahviour and at higher temperature it shows a semiconducting property wth a transition at around 400°C.*



3.7 Photoelectrochemical behavior of Chumbakmani

A photoelectrochemical cell of configuration "Pt/panchloha/chumbakmani/electrolyte/Pt" was fabricated as shown in figure 1. Various types of electrolytes including pargrandhikdrav were used to study the photoresponse of the cell. Photocurrent and photopotential were measured and results are shown in table-3

Table 3. *Photoelectrochemical response of chumbakmani with different electrolytes*

Electrolyte	Photocurrent (μA/cm²)	Photo potential (mV)
Fe3+/Fe2+ pH 1.0	161	51.6
Ce4+/Ce3+ pH 1.0	5.4	Not stable
Ferro/ferric cyanide pH 13	180	9.0
KI/KI3 pH 6.6	137	62.0
Pargrandhikdrav	700	195.0

These results suggest that pargrandhikdrav is better electrolyte togive the highest photocurrent and photo potential. It was also noticed that after a prolonged exposure to sun light pargrandhikdrav changed its colour and reversibility of photocurrent was spoiled. Though it was not possible to find out the band position of the chumbakmani, but by examining the results shown in table3, it appears that band positions (i.e. conduction and valence bands) should be such thatredox potential of pargrandhikdrav must be in between the conduction and valence band of chumbakmani.

4. Conclusion

The purpose of this experiment was to confirm whether the recipe written in the book of Maharshi Bhardwaj, is scientifically authentic. Since the book contained several hundreds of recipes, it was decide to work on one unit named GuhagarbhadarshanYantra. This yantra is made by combining three units: Chumbakmani, Panchloha and Pargrandhikdrav. Recipes are given in slokas (Figure 6).

Chumbak Mani

चुम्बकशर्क रटङ्कणदन्त्यं शौण्डिकपारदपार्वण शुल्वम् ।
रञ्जिकमाक्षिक गृदिनकसौरिं महिषखुरं तद्विश्वकपालम् ॥

Paragrandhik Drava

पारं वैणविकं चैव लम्बोदर मृत्कुण्डके ।
जटाग्रध्रि पार्वाणिकं स्वर्णवीजं घटोद्गङ्गम् ॥

Tanogarbha Loha

कृष्णासिसं चाञ्जनिकं वज्रतुण्डं समांशतः ।
संयोज्य मत्स्यभूषायां काकण्यासटिकान्तरे ॥

Chumbakmani is made by a technique presently known as flux technique. This flux is very reactive and dissolves oxides of iron, sand etc even at 600^{o}C and when heated to 1250^{o}C it produces a magnetic material which shines like diamond (mani). This flux is very useful for melting high melting point metals. Chumbakmani behaves like metal upto 400^{o}C and at higher temperature it shows semiconducting properties. This suggests that this metal can be used as a sensor also. Guhagarbhadarshanyantra converts light energy into electrical power. Such instruments are known as photoelectrochemical cell [2-3].Pargrandhikdrav is light sensitive liquid.

In conclusion, these experiments have confirmed that the technique and the materials used for making the Guhagarbhadarsh-anYantra are genuine and scientifically they can be reproduced. It is therefore suggested that there is a need to study this book more thoroughly to find out other products described in the book.

5. Acknowledgment

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6. References

1. Maharshi Bhardwaj Brihad VimanShastra. Sami Bhrammuni Parivrjak & Gurukul Kangkadi (Haridwar) (Eds.) Sarvdeshik Aarya PratinidhiSabha Publ. Dayanand Bhavan, New Delhi, India.

2. A, Fujishima and K.Honda (1972) 23837

3.Maheshwar Sharon, P. Veluchamy, C. Natrajan and Dhananjay Kumar (**1991**) *Electrochimica Acta* 36 (7), 1107 -11026.