A STUDY OF CRYOGENIC SURGERY WITH NANOPARTICLES

Chandran. M.[1], **Senthil kumar. P.** [2]

[1,]Research Scholar, Sathyabama University, Chennai, India
[2]Professor, K.S.R College of Engineering, Thiruchengode India
Email: [1]cryochandran200886@yahoo.in

Abstract

The most important drawback in cryosurgery is insufficient or inappropriate freezing which will not completely destroy the target tissues tumor, and as a result, it may lead to tumor regenesis and thus result in failure of treatment. The surrounding healthy tissues may suffer from serious freeze injury due to unavoidable release of a large amount of cold from the freezing probe. To solve this problem, a new technique called cryonanosurgery is introduced in which nanoparticles are mixed with cryogens to maximize the freezing and there by minimize surrounding healthy tissues from being frozen

Key words: cryonics; cryonanosurgery; cryogens; tumar, freeze; tissue; technique

I. CRYOSURGERY

Cryosurgery, also known as cryodestruction or cryotherapy, is the removal of abnormal or diseased tissue by freezing, usually with liquid nitrogen. The technique is used to treat cancerous tumors, control pain, control bleeding, and reduce brain tumors. Cryosurgery has been used to treat skin lesions for approximately 100 years. The first cryogens were liquid air and compressed carbon dioxide snow. Liquid nitrogen became available in the 1940's and currently is the most widely used cryogen. Liquid nitrogen, which boils at $-196°C$ ($-320.8°F$), is the most effective cryogen for use in a clinical setting. To destroy diseased tissue, the tissue is cooled to $-20°C$ to $-30°C$ ($-4°F$ to $-22°F$). Temperatures of $-25°C$ to $-50°C$ ($-13°F$ to $-58°F$) can be achieved within 30 seconds if a sufficient amount of liquid nitrogen is applied by spray or probe Cryosurgery is a minimally invasive procedure, and is often preferred to more traditional kinds of surgery because of its minimal pain, scarring and cost.

Cryosurgery is used to treat several types of cancer, and some precancerous or non-cancerous conditions. Cryosurgery is also used to treat some types of low-grade cancerous and non-cancerous tumors of the bone. It may reduce the risk of joint damage when compared with more extensive surgery, and help lessen the need for amputation. The treatment is also used to treat AIDS-related Kaposi's sarcoma

II. NANOPARTICLES

Nanoparticles *was* first developed approximately 35 years Ago nanoparticles are stable, solid colloidal particles consisting of biodegrade polymer or lipid materials Nanoparticles are sized between 100 and 1 nanometers and they're used to treat cancer. The small size of nanoparticles endows them with properties that can be very useful in oncology, particularly in imaging. Quantum dots (nanoparticles with quantum confinement properties, such as size-tunable light emission), when used in conjunction with MRI (magnetic resonance imaging a successes of cryogenic engineering), can produce exceptional images of tumor sites. These nanoparticles are much brighter than organic dyes and only need one light source for excitation. This means that the use of fluorescent quantum dots could produce a higher contrast image and at a lower cost than todays organic dyes used as contrast media.

III. NANOTECHNOLOGY

In recent years, nanotechnology researchers are achieving astonishing results in many fields of medicines, one of the most promising and exciting progress has been shown in the field of cryosurgery. Introduction of nanoparticle can enhance freezing and also make conventional cryosurgery more flexible in many aspects such as artificially interfering in the size, shape, image and direction of ice ball formation. Nanotechnology has the potential to impact surgical practice directly and indirectly. Nanotechnology is nothing but a technology which uses atom with a view to creating desired product. It has wider applications in all the field.Theimportant application of nontechnology is Cryonics. Nanotechnology will enable manipulation of matter at the molecular level.

IV. CYRO NANOSURGERY

The concepts of cryonanosurgery may offer new opportunities for future tumor treatment. cryonanosurgery is closely related to the advanced Nano-technologies. The Nano cryosurgery is deeply rooted in the test advancement of a nontechnology, Experiments and theoretical analysis indicate that, once nano particles are implanted into target area, not only the maximum freezing rate inside the target could be increased during cryosurgery compared with the conventional approach, but most importantly, the possibilities of ice nucleation could also be significantly improved which would induce an enlarged death of tumor cells. Such innovation is quite beneficial to raise the curative effectiveness of conventional cryosurgery and decrease the recurrence rate of post-cryosurgery. In addition, introduction of nanoparticles during cryosurgery could also help better image the edge of tumor as well as the margin of the ice ball. This is very important in guaranteeing a successful cryosurgery. Such merits may lead to a highly “green” therapy on tumor. Nano particles would further improve the effective killing rate of tumor cell with the combination of cryosurgery, except for adopting the highly conductive nano materials. Nanoparticles with lowered thermal conductivity can also have unique virtue in cryosurgery.

V. MATERIALS AND METHOD

Cryosurgical treatment is performed with mini cryogun (model Inc-196) liquid nitrogen storage devices adapted to different types of cryoprobes used in the cryosurgery till ice ball is formed. Nanoparticle solution is loaded for administrating the cryonanosurgery that is .nanoparticles are mixed with functional solution and injected into the target tissue. Addition of nanoparticle into a wet biological environment will increase the tissue conductivity and thus significant freezing effects and more efficient ice formation. cryonanosurgery can be tested with mice and human trails will also be held with volunteers

VI. CRYONICS (NANOTECHNOLOGY)

Cryonics is new medical technology based on a mature nanotechnology since the early 1960s, people have seriously discussed the idea of freezing those who die in the hope that future technology would be able to revive them and restore them to health. This process is known as cryonics (molecular nanotechnology) was likely to be used to revive those in cryopreservation, one man has already been cryonically suspended in liquid nitrogen continuously since 1967.Nanotechnology has wider applications in all field. The important application is Cryonics. Nanometer isone billionth of a metre.

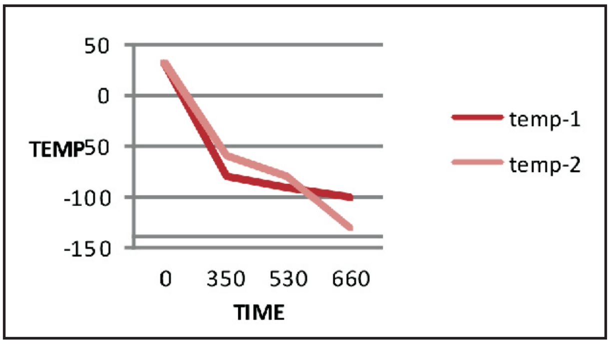


Fig. 1 Temperature vs. time

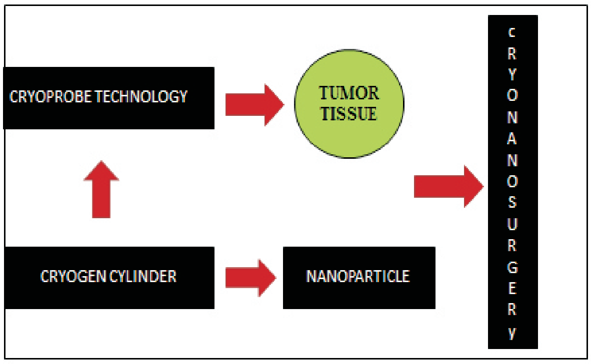


Fig. 2 Process of cryonanosurgery

Fig. 3 Cryoprobes tips

VII. BIO HEAT EQUATIONS

Calculations of heat transfer are based on the widely accepted bio heat model proposed by Penne’s, which is widely used in the description of the tissue freezing process

$$\frac{\partial (\rho h)}{\partial t} = \nabla \cdot (\nabla \text{Kt}) + \rho_b C_b \omega_b (T_b - T) + q_{met} \ldots (1)$$

where ρ is the density of the tissue, and where ρ_b is the density of the blood; h, enthalpy; t, time; ω_b the blood perfusion rate (ml.s^{-1}.ml^{-1}, the volumetric blood flow rate per unit volume of tissue); T_b, the blood temperature and T, the tissue temperature; C_b, the specific heat capacity of blood; q_{met} , the metabolic heat generation (W.m^{-3}).The second and the third terms of Equation are the heat source contributions from blood perfusion and metabolic heat generation respectively. The sum of the two terms is the total heat source, marked as "*Q*". Equation is based on the assumption that blood in the biological tissue is supplied with an isotropic capillary network and it enters the tissue at the blood temperature of the major supplying artery and leaves the tissue at tissues temperature.

Table 1. Thermal properties of soft biological tissue

parameter	unit	valve
Blood perfusionrate	ml.s^{-1} ml	$\leq$ 0.011
Metabolic heat generation	KWm^{-3}	33.8
latentheat	MJ.m^{-3}	250
specific heat of frozen tissue	$MJ \cdot m^{-3°}C^{-1}$	1.8
specific heat of unfrozen tissue	$MJ \cdot m^{-3°}C^{-1}$	3.6
Thermal conductivity of frozen	$w \cdot m^{-1°}C^{-1}$	0.5
Thermal conductivity of unfrozen	$w \cdot m^{-1°}C^{-1}$	2
Blood temperature	°C	37

ACKNOWLEDGEMENT

This work is partially supported by Professor of Surgery of A.C.S. Medical College and Hospital, Director of Thaimoogambigai Dental College Hospital Chennai.

REFERENCES

[1]. M.Chandran, Dr P.Senthil Kumar "A Pilot study of cryonano surgery and cryonics" in the International Conferences on Nano Science, Engineering nd Technology (iconset 2011) on 28 -30 November, 2011 held at at Sathyabama University Jeppiaar, Nagar Chennai-600119. India ISBN NO:978-1-4673-0072-8 (proceedings, page 547-549.)

[2] M.Chandran, DrP.SenthilKumar "Heat transfer in cryonanosurgery'' in the 2nd International Conference on advances in mechanical, manufacturing and building sciences (icamb 2012) on 9-11 January 2012 held at at VIT University Vellore Tamil Nadu, India-632014. (Proceedings page 855-858).

[3] M.Chandran, Dr.SenthilKumar "Heat transfer in cryonanosurgery'' in the International Conference on recent trends in advanced materials (icram- 2012,sas) on 20-22 February 2012 held at at VIT University Vellore Tamil Nadu, India-632014 (proceedings page 147).

[4] Chandran, Dr.P. SenthilKumar A Pilot Study of Cryo Bio Remediation'' in the National Conference on Marine Environmental Challenges and Coastal Zone Management Strategy (Marina- 2012,) on 13-14 February 2012 held at Bharathidasan University Thiruchirapalli Tamil Nadu, India-632014 (proceedings page 19).

[5] M.Chandran, Dr.P. SenthilKumar. 'A 'Study of C. ryogenic Green (environment/clean) technology' in the National Conference on Trends in Renewable Energy, Sources, Applications & Technologies (TRESAT- 2012) on 1-3 February 2012 held at at Sathyabama University Jeppiaar Nagar Chennai-600119, India, Tamil Nadu, India-632014, ISBN NO:978-81-9221119-3-0 (proceedings page 104-105).

[6] M.Chandran, Dr P. Senthil Kumar "Cryonanosurgery for the tremeant of cancer" in the 2nd Conferences on Nano Technology at the bio-medical interface (nanobio 2012) on 21-23 February, 2011 held at Amrita University, Amrita Centre for Nano sciences & Molecular Medicine and Amrita Institute of Medical Sciences, Kochi Kerala India (proceedings, page 157)

STUDIES ON METAL (Cu & Sn) EXTRACTION FROM THE DISCARDED PRINTED CIRCUIT BOARD BY USING INORGANIC ACIDS AS SOLVENTS

Vijayaram R[1], Chandramohan K[2]

[1,2] Department of Chemical Engineering, Kongu Engineering College Perundurai, Erode, INDIA.
E-Mail: [1]vijayaram.rajaram@gmail.com

Abstract

This Project deals with the experimental results of the leaching of metal like Cu and Sn from Printed Circuit Boards (PCB) from obsolete electronic devices by means of leaching using different combinations of acidic mixtures followed by precipitation. Printed circuit boards were dismantled, cut into small pieces, and fed into a Ball mill. The powder obtained was leached by using the aqueous solutions H_2SO_4, H_2SO_4 + HCl, HCl, and HCl + HNO_3. The lowest values for the percentage of metal extraction were obtained with H_2SO_4 while the HCl + HNO_3 mixture exhibited an extraction of Sn and Cu in an maximum percentage. Precipitates were obtained at different pH values by neutralizing the leach liquors using NaOH. The HCl + HNO_3 leach system presented the highest recovery values from the powder feed as well as from the leach liquor. Comparing the results for Sn and Cu extraction after 120 minutes obtained with the various leach systems, 3.0N HCl + 1.0N HNO_3 exhibited the highest percentage values for simultaneous Sn and Cu extraction (93.3%Sn and 92.7% Cu).

Keywords: Tin; Copper; Recycling; Electronic scrap, Extraction

I. INTRODUCTION

More than millions of Electronic devices have been installed over the past two decades. As new and more efficient electronic devices come onto the market, significant numbers of old electronic devices are being scrapped. Likewise, the number of obsolete electronic devices has also been growing. Due to the lack of specialized companies working with the recycling of obsolete electronic devices, such equipment is commonly scrapped in inappropriate disposal areas, together with domestic garbage, with no specialized recycling processes.

Printed circuit boards used in electronic devices are composed of different materials, such as polymers, ceramics, and metals, which render the process of scrappers even more difficult. The presence of metals, such as tin and copper, encourages recycling studies from an economic point of view. However, the presence of heavy metals turns this scrap into dangerous residues. This, in turn, demonstrates the need for solutions to this type of residue so as to dispose of it in a proper manner without harming the environment. The recycling of printed circuit boards from obsolete electronic devices is, at present, a fairly new activity, although opportunities are available for expansion in this area. For instance, gold, silver, tin, and copper, among other metals, can be recovered by means of the hydrometallurgical treatment of printed circuit boards.

Most hydrometallurgical treatments use leaching as one of the main stages. Leaching is the process of extracting a soluble constituent from a solid by means of a solvent. In extractive metallurgy, it is the process of dissolving minerals from an ore or a concentrate, or dissolving constituents from metallurgical products.

Lead, tin, and Copper were successfully recovered from alloy wire electronic scrap through acid/alkali leaching and an NaOH solution was added to the leach liquor for metals precipitation. Some researchers have also been working on the recycling of electronic scrap.

II. RECYCLING

The Recycling process can be done by two methods

Thermal Processing

In Thermal processing the printed circuit boards can be recycled by applying enormous amount of heat. In this process technique three stages are involved. They are as follows

- Pyrolysis
- Hydration
- Metallurgy

Non-Thermal Processing

This is another way of recycling the printed circuit boards. This method is simple and easy to handle the feed materials. This process includes

- Dismantling or Disassembly
- Grinding or Crushing
- Separation
- Chemical Treatment

Table 1. Composition of PCB

Metals	Percent Availability
Copper	17-19
Aluminium	7-8
Zinc	0.1
Tin	3.25
Nickel	0.05
Iron	2.9
Lead	4.0
Silver	Traces

III. MATERIALS AND METHODS

In this Project we have handled the non-thermal processing technique as shown in fig-1. The Printed Circuit Board was crushed in a ball mill and sieved to separate according to size of 0.2mm. The undersized particle was separated which is feed to the Leaching mixture. The powdered PCB was dissolved in a leaching mixture of acids in different combination. Copper and Tin present in the PCB are allowed to dissolve in the acidic solutions. The amount of metals dissolved in the solution can be determined by using the AAS or by the volumetric analysis method. The concentrations of inorganic acids used in these tests are determined by volumetric analysis. The use of high concentrations of acids was allowed to control the experimental costs. About 10gms of PCB powder was allowed to react with the 100ml of the leach solution of different concentration.

The experiments were carried out at $60 \pm 2°C$. Samples of the leach liquor were collected at intervals of 10, 30, 60, and 120 minutes during the experiment.

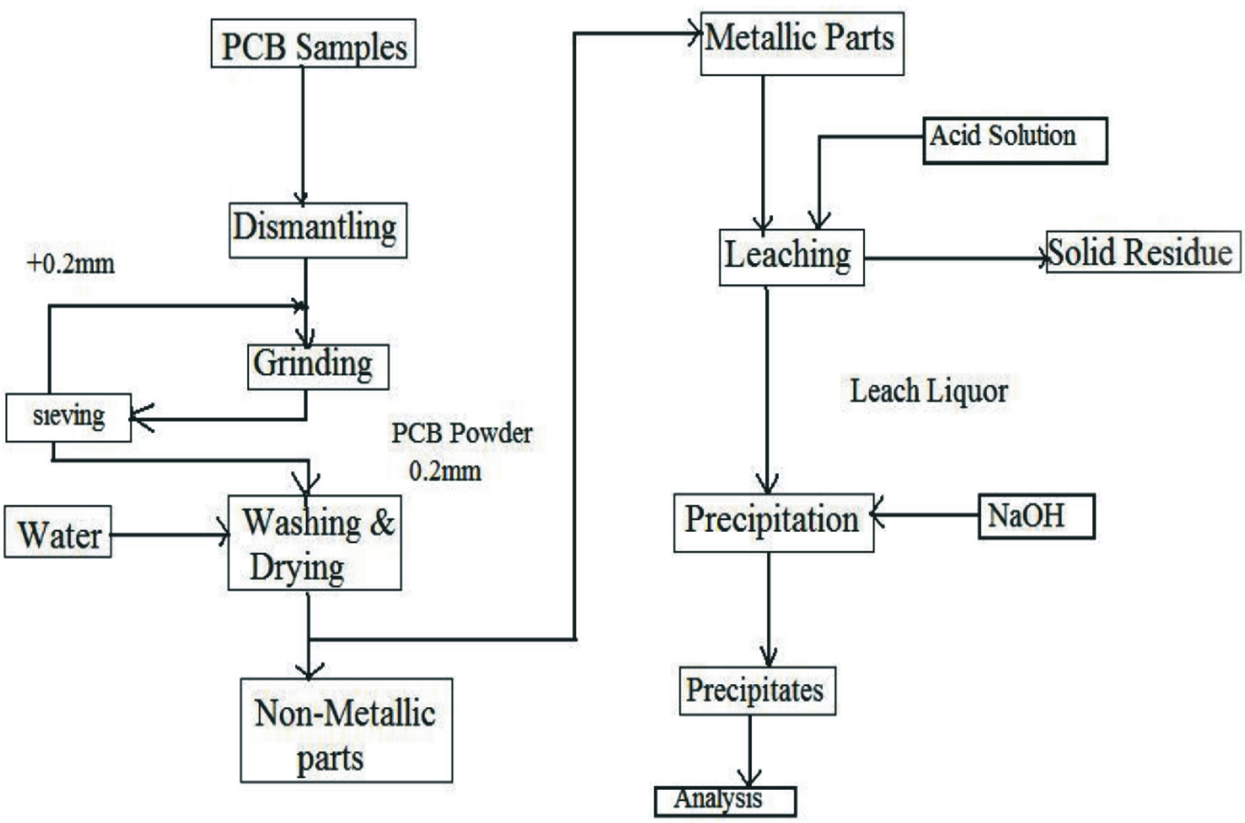


Fig. 1. Block diagram of the process

Leach liquor samples were collected, filtered and sent for chemical analysis to determine tin and copper concentration in aqueous solution.The samples were collected and analysed for Cu and Tin using Volumetric Analysis.

IV. RESULTS AND DISCUSSIONS

Table 2. Percentage of Cu & Sn obtained from leached acidic solution after 120 min,

S. No	Leaching mixture	% Copper	% Tin
1	2.18 N H_2SO_4 + 3 N HCl	8.5	58.2
2	3 N HCl +1 N HNO3	92.7	93.3
3	3N HCl	23.8	85.1
4	2 N HCl + 2 N HNO_3	75.85	76.7
5	3 N HCl + 2N HNO_3	46.71	89.48
6	3 N HNO_3	86.95	93.3
7	2.5 N HCl + 2.5 N HNO_3	52.42	92.21

It was found that the leach liquor of concentrations 3.0N HNO_3 and 3.0N HCl + 1.0N HNO_3 leach systems were the most efficient to recover Tin and Copper (93.3% and 92.7%) simultaneously.

Tin and copper content in the powder generated by the processing of PCBs from obsolete electronic devices is 3.25% Sn and 3.5% Cu. Thus the leach can be considered to be highly significant when compared to the content found in primary mineral sources.

The percentage of tin and copper extracted in the 2.18N H_2SO_4 +3 N HCl (58.2% and 8.5%) leach system showed the lowest results among the leach systems under study, while the 3.0N HCl + 1.0N HNO_3 (93.3% and 92.7%) system presented the highest results for simultaneous tin and copper extraction (using one stage leaching).

The precipitates obtained through the neutralization of the leach liquor from the 2.18N H_2SO_4 +3 N HCl systems exhibited the lowest results for tin and copper recovery from the powder feed and from the leach liquor. The 3.0N HCl + 2.0N HNO_3 system presented the highest values for simultaneous tin and copper recovery.

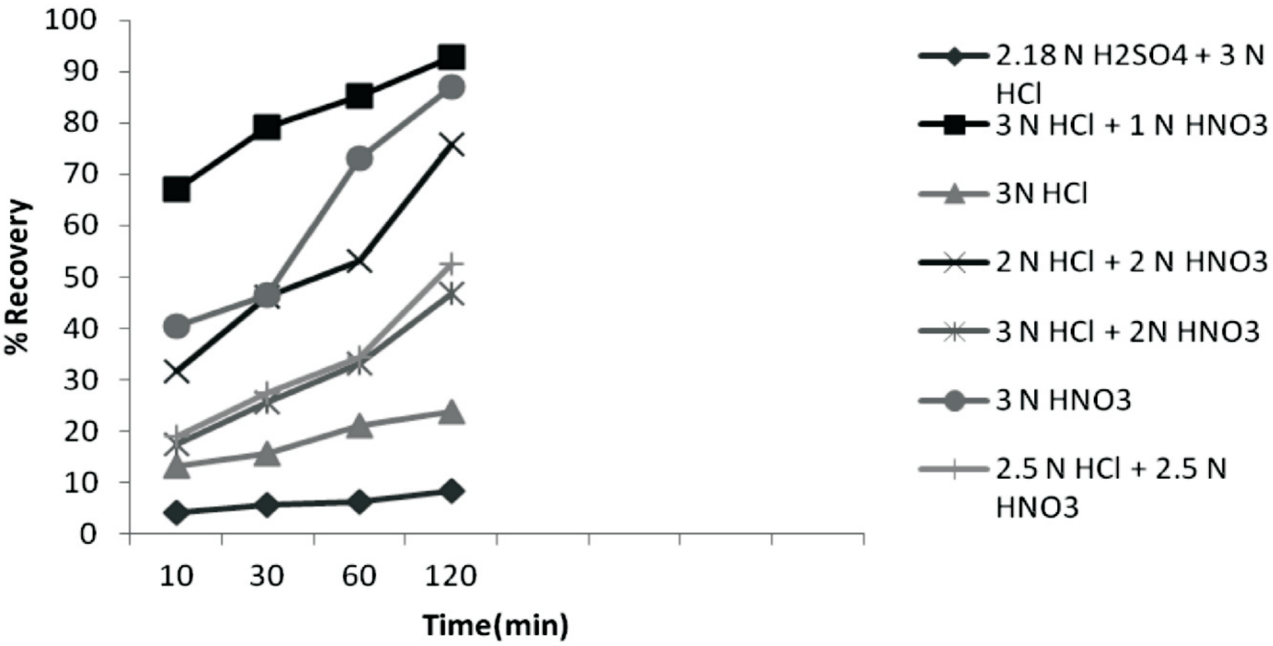


Fig. 2. Cu recovery vs. Reaction Time

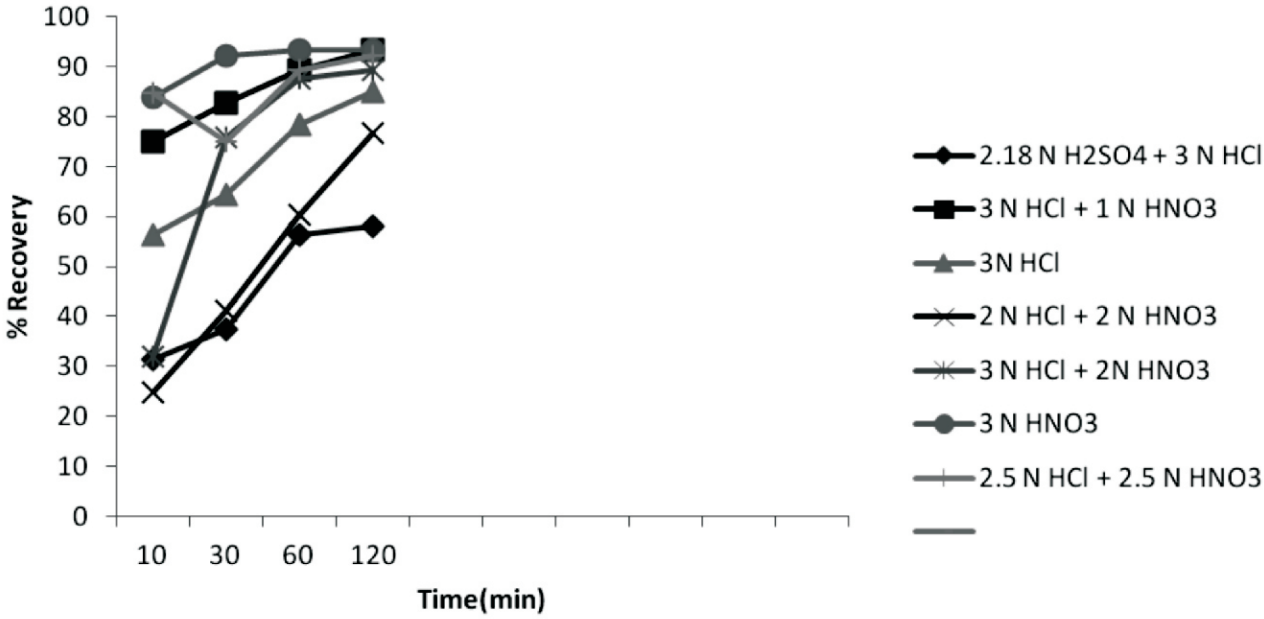
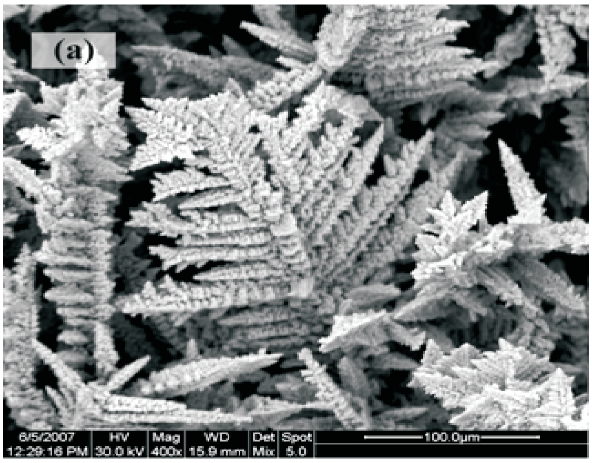
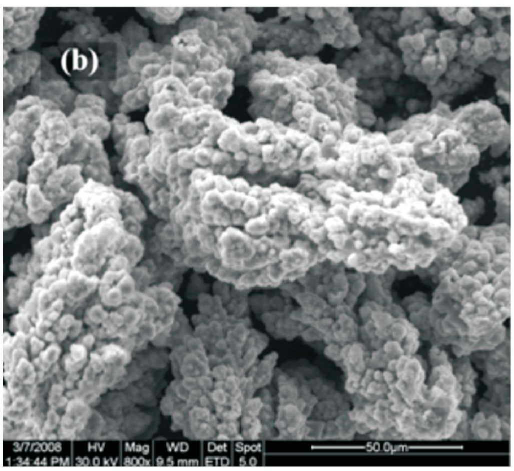


Fig. 3 Sn recovery vs Reaction Time

(a) H_2SO_4 solution



(b) HNO_3 solution



(c) HCl solution

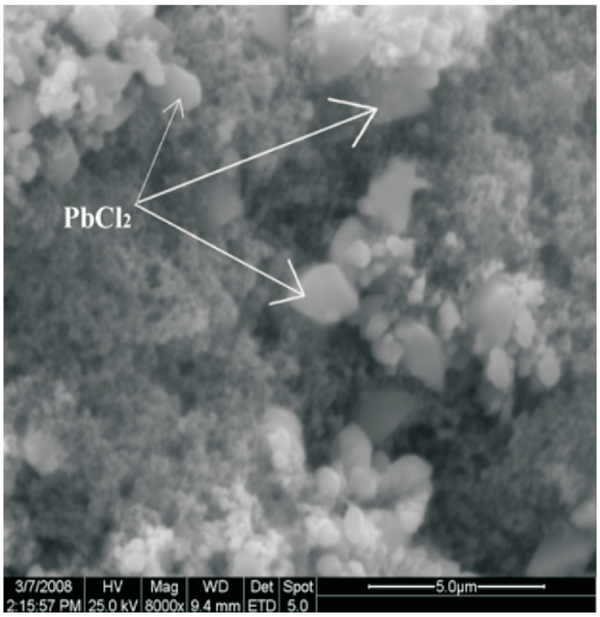


Fig. 4. SEM images of recovered copper revealing the dendriticmorphology from

Concerning the morphology of the recovered copper, SEM images revealed dendritic growth of the deposits obtained from all three individual acid leaching solutions Figures 4 a,b,c. Specifically, in the case of the copper obtained from the sulphuric acid solution the recovered metal presented Fine dendritic structure with branches of about 80 – 100 μ m (Figure 4a). On the other hand, copper deposited from nitric or hydrochloric acid solutions demonstrated a more compact structure although a dendritic structure was conserved.

CONCLUSION

E-waste is an emerging issue, driven by the rapidly increasing quantities of complex end-of-life electronic equipment. The global level of production, consumption and recycling induces large flows of both toxic and valuable substances. Although awareness and readiness for implementing and Improvement is increasing rapidly, there are many obstacles to manage end-of-life products safely and effectively in industrializing countries.

Support securing economic efficiency and sustainability of e-waste management systems by optimizing the value added and improve the effectiveness of collection and recycling systems.

REFERENCES

[1] Industrial ecology engineering department. Texas university-USA.79409.

[2] Wernick and N.J. Themelis, "Recycling Metals for the Environment"Annual Reviews Energy and Environment, Vol. 23, p.465-97, 1998.

[3] Cui, J.; Forssberg, E. Mechanical recycling of waste electric andelectronic equipment: A review. J. Hazard. Mater. 2003, 99, 243–363.

[4] Anuário Mineral Brasileiro 2006, versão eletrônica (Mineral Summary 2006) (2006). Departamento Nacional de Produção Mineral (National Department of Mineral Production), Ministério da Minas e Energia (Ministry of Mines and Energy), Brasília, Brazil, (Accessed on February 12, 2008).

[5] Barakat, M. A., Recovery of lead, tin and indium from alloy wire scrap, Hydrometallurgy, 49, 63-73 (1998).

[6] Lee, M. S., Ahn, J. G., Ahn, J. W., Recovery of copper, tin and lead from the spent nitric etching solutions of printed circuit board and regeneration of the etching solution, Hydrometallurgy, 70, p. 23-29 (2003).

[7] "Copper Leaching Behavior from Waste Printed Circuit Board in Ammoniacal Alkaline Solution"Kazuya Koyama, Mikiya Tanaka and Jae-chun Lee -Materials Transactions, Vol. 47, No. 7 (2006) pp. 1788 to 179 #2006 the Mining and Materials Processing Institute of Japan.

[8] "selective leaching for the recovery of copper from pcb" Md Fazlul Bari, Mst. Noorzahan Begum, Shamsul Baharin Jamaludin, Kamarudin Hussin School of Materials Engineering, University Malaysia Perlis, 02600 Arau,Malaysia.

[9] "Selective Leaching of Valuable Metals from Waste Printed Circuit Boards" Chi Jung Oh and Sung Oh Lee Korea Chemical Co., Kwangju, Korea Hyung Sik Yang, Tae Jun Ha, and Myong Jun Kim Department of Civil, Earth, and Environmental Engineering, Chonnam National University. ISSN 1047-3289 J. Air & Waste Manage. Assoc. 53:897–902 Copyright 2003 Air & Waste Management Association

[10] "Effective electronic waste management and recycling process involving formal and non-formal sectors"S. Chatterjee and Krishna Kumar. International Journal of Physical Sciences Vol. 4 (13) pp. 893-905, December, 2009.

[11] Recovery of copper from printed circuit boards scraps by mechanical processing and electrometallurgy Hugo Marcelo Veit , Andrea Moura Bernardes , Jane Zoppas Ferreira, Jorge Alberto Soares Tenorio , Celia de Fraga Malfatti. Journal of Hazardous Materials B137 (2006) 1704–1709.

R.Vijayaram graduated in Chemical Engineering at Kongu Engineering College, Perundurai, Erode in the year 2010. He also holds a postgraduate diploma in Industrial Safety. He has presented papers in national seminars and conferences. He is currently doing his post graduation in Chemical Engineering at the same college.