COMPANY PROFILE

Figure : Institute logo and research center.

Figure shows that **Visvesvaraya Institute of Advanced Technology**, also known as VIAT, is a research institute being constructed near Muddenahalli, Karnataka, India. The research institute was proposed on Engineer's Day 2008 in Muddenahalli, the birthplace of legendary engineer, Sir Mokshagundam Visvesvarayya. The foundation stone was commemorated by MP Veerappa Moily in February 2010. The institute is located on 200 acres (0.81 km^2) ofland nestled in the Nandi Hills and is expected to cost 600 crores.

In the initial years, VIAT will focus on research in embedded technology, software quality, agricultural engineering and bioengineering. Each department will function as a "discovery-innovation centre." The institute will offer graduate and PhD level courses in the sciences andwill be starting a 50 crore joint automotive research and design centre with Bosch at Muddenahalli.

The research institute is a branch of Visvesvaraya Technological University (VTU) one of the largest technological universities in India, having 186 colleges affiliated to it with undergraduate (UG) courses in 28 disciplines and postgraduate (PG) programs in 71 disciplines. The intake at UG level is nearly 67,100 students; at the PG level it is about 12,666 students. The University has memorandums of understanding (MOUs) with various leading organizations like IBM, Bosch, INTEL Asia Electronics Inc., Ingersoll-Rand (India) Ltd., and Microsoft. VIAT will offer diversified and advanced engineering courses, and will develop MOUs with select foreign universities to offer some of their courses. This institution will cover all three major aspects of modern higher education such as formal education leading to the award of UG and PG Degrees, sponsored R&D and industrial consultancy, continuing education, education technologies and societal interactions.

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CHAPTER 1

INTRODUCTION

Battery is a storage box which can store a certain amount of electrical energy in the form of electrons and can discharge with certain velocity. They are divided into two main types rechargeable and one time use battery. The present era is trending towards rechargeable batteries to reduce the wastage. The battery consists of two electrode and an electrolyte, electrode anode and cathode (positive and negative) which would accept and transmit electrons in which electrolyte acts as pathway [1].

Nanotechnology is a branch of engineering which talks about the the characteristic behavior of material when they are nanometer in size. The parameters such as chemical, physical, optical and structural behave differently when their size is in the range of nanometers. This properties are said to be playing a major role in the consistently developing technology and the human needs that are to be full filled. Users prefer to have a very small and ease to under stand and user friendly instead of bulky and complex to understand. The circuits are to printed in the size way less then the diameter of human hair but then to gives you the sane output value, this technology requires a lot of accurate designing and precision pointing of the elements on to the circuits. Nano technology is the upcoming industry which has a lot of potential in the field of electronics as we are moving into an smart era or AI-automation era which requires a lot of technical advancement which can be see been developed in this branch of engineering [1].

Nanotechnology is a been around since the formation of this earth. As popular theory says that every single life on this earth begin with the reaction in nano-scale which lead to the formation of the living thing in this world, every single living things in this universe is made up of the this nano particles, we can call this particles as the building blocks of the living things in our world. It was first introduced the concept by Laureate Richard Feynman 1959 this brought in a revolution in this industry that we started thinking beyond what we cansee and also expanded are way of thinking, this lead to a lot of development and also helps to understand a lotof unexplained phenomena and this also lead to inventions of a lot of devices which allowed us to study and create a lot of advance technology [2].

Surface effect is the phenomena which takes place in a material, as the large scale material is reduced to nano scale particles is surface area increases in exponentially scale thus increasing the reaction surface exponentially. As the material is broken down to nano scale the mass will remain constant but the surface area increases thus increase in surface area to mass ratio. The optical properties of the nano materials, such as reflection, refraction, diffraction, absorption, etc. This properties are the result of the structural organization in the material, this are also the result of the size of the particle. This can be studied under SUPERCONTINUUM LASER-BASED INSTRUMENT [2].

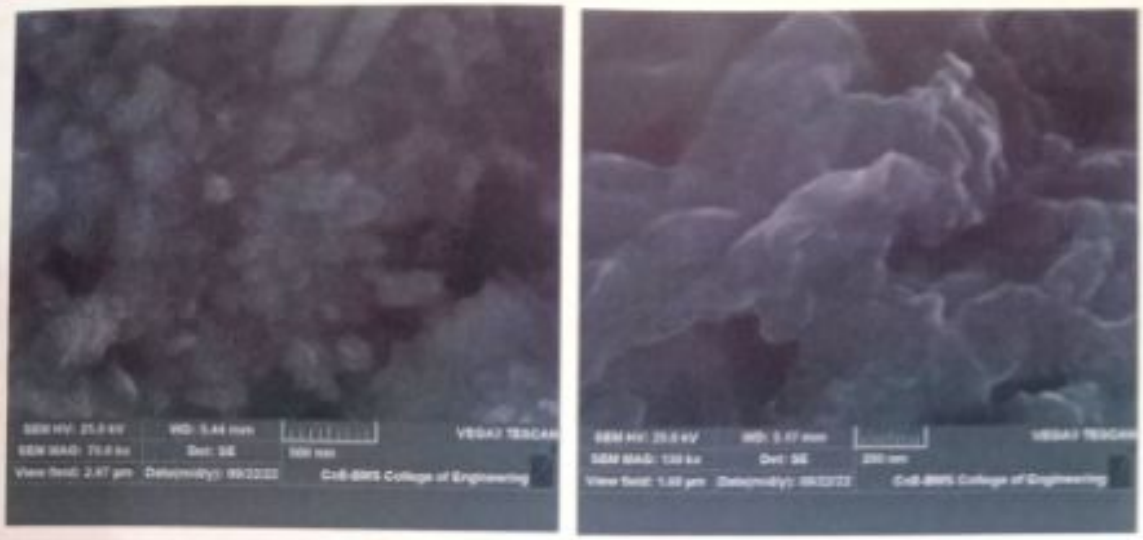


Figure 1.1: the nano particle's image in scanning electron microscope.

The figure 1.1 shows the Nanomaterials are materials which at least one external dimension that measurs 100 nanometers or less. They have the same compostion as their bulk materials but There are several difference in the characteristic and properties differ three types of nano particular. 1D,2D and 0D. In which 1D has only one of the dimension is in nano scale for example nanotubes, nanorods and nanowires . In 2D two of the dimension of the material is in nano scale for example graphene, nanofilms, nanolayers and nanocoatings. 0D is that kind of material in which all the dimension are in the range of nano scale for example quantum dot [3].

The electrical properties is the most important property in the prospective of this project as it is based on the topic of battery and its management technique. The electrical property will help to under stand the conductivity, resistivity, electron flow and ability to withhold the electrons in side them self. The mechanical properties of the nano materials are the strength and ability of the material to withstand the ware and tare, heat, environmental damage and long usage life. This are the very basic requirements for the bulk production of the material. Our project is mainly bulding a sustainable electrochemical cell out of the wast metal like copper, stainless steel, iron, aluminium and brass. The ideia is to produce and efficient and effective cell that can be commercially used. We are using the commonly found alloys like stainless steel and brass, this are the man made metals which are better in comparison of other natural metals in many ways [1].

A variety of metal oxide nanostructures like Fe3O4,CuO2, CosO4 and A1O3, this are some of the oxides that are used in protecting the main metal from reaction with the surrounding. This layer of the oxide will also improve the life and efficiency of of the metal if it is used as electrode in a battery and also this help in formation of a rechargeable battery, by keeping the electrode intact with out letting it to get degraded in the presents of electrolyte, the deposition of oxide layer will defiantly reduce the discharging capacity but

will stand longer, but if the oxide layer is very thin then it not have that effect on the conductivebut still have equal protection so the layer of oxide is to be in nanometers so that [4].

The main aim of the project is to deposit a 1D nanomaterial layer of oxide on the top of a test simple, thermal oxidation is the processes that is been used for the formation of the oxide layer on the top of the test simple. This process is not the most promising way of oxidation but the better then chemical method because we can control the thickness of the oxide layer, this is a very important property for this project withthe uniform layer formation with it zero irregularity in the layer formation. The instrument that is been used is the tube furnace this is tubular in shape and would distribute the heat equally and have a equal layer formation on the test subject [5].

This aim of oxide layer is to use it to build a good battery out of the commonly used metals and study its advantage and its drawbacks which can help us to under stand and possibly find an alternative battery to the Li-ion battery and lead acid battery as the metals are very expensive to find and are very hard to extract and there is very less amount of this metals are lest in the earths core. As this present demand of battery is increasing as we are turning towards e vehicle and this depend on the batteries and their management for their performance as a result there is always a room of upgrade and its replacement with new and better hardware [13].

The test simple that we used is the mild steel and brass as they are the most commonly found metals. This metals are selected because of the availability and its properties to withstand heat and weather. The composition of the mild steel consists of iron and carbon and the composition of brass is copper and zinc. This type of metals are known as alloy this are the one which made by human to replace the natural metals. The oxide layer that we are expecting to find are FeO on mild steel and CuO on to brass. This oxide layer may change accouring to the composition of the metal. The only way to know the composition of oxide layer is by subjecting the metal under scanning electron microscopy (SEM), X-ray diffractometry (XRD) and cyclic voltammetry setup [12].

CHAPTER 2

2.1 MATERIALS

Table:2.1 Materials

Sl.No	Material in use	Its composition	Comment
1.	Mild steel	Iron and carbon	It is a aloye of iron and carbon with this we are trying to oxidize and use it as an electrode
2.	Brass	Copper and zinc	It is a alloy of Copper and zinc with this we are trying to oxidize and use it as an electrode
3.	HC1	Hydrogen and chloride (concentrated)	The acid is used for secondary cleaning the metal and remove all the impurities on it.
4.	Sand paper	Paper with abrasive material glued on to one side	The sand paper is used for primary cleaning the metal and remove all the impurities on it.
5.	KC1	Potassium and chloride (0.5 molar)	It is used as electrolyte to help in the conduction of the cell.
6.	Referenced electrode	Ag/AgCl	Electrode whose potential is known and can be used to determine to potential of other electrode.
7.	Counter electrode	platinum	The electrode which is used to consume the extra current generated.

2.1 INSTRUMENTS

The instruments in use are:

Table 2.2 instruments

Sl.No	INSTRUMENTS	COMMENT
1.	Tubular furnace	It is used to oxidize the metal
2.	Cyclic voltammetry setup	It is used to plot the CV curve
3.	Scanning Electron Microscopy (SEM)	To analyse the nanopartical imageand its characterization
4.	X-Ray Diffractometry (XRD)	To study the composition of thematerial in use
5.	Electrochemical potentiometer	Used to create a elector chemicalcell

2.1.1. Tubular furnace

A tube furnace is an electric heating device used in heating a given material in the presence of air. The possible design consists of a cylindrical cavity surrounded by heating coils that are embedded in a insulating matrix. This furnace can go up to 1100°C and can withstand a large rage of temperature for longer time. It was first invented in the 20* century and has been a very much useful in the manufacturing of ceramic filaments. The cleaned test subject is placed in a crucible and kept inside the furnace, as the furnace is automated, the user must specify the time and the pick temperature to be heating the test subject [7].

The instrument that we used was from Thulir Vacuum Technologies which has an accuracy of +/- 1°C, it works under 230 voltage, and its operating temperature range is 600-1000°C, with max, temperature is 1100°C and it can also work under 10 3 vacuum [7].

Figure 2.1 : Tubular Furnace.

The figure 2.1 shows the tubular furnace that is used in the oxidation of the test material. For Mild-steel at 1000°C for 20 minutes and for Brass 500°C for 4 hours. This process helps to build a oxide layer on the top of test material, this method also helps us to precisely fix the thickness of the oxide layer formation.

2.1.2. Cyclic Voltammetry setup

A powerful and popular electrochemical technique used to calculate the charging and discharging of a cell this help us to build a better battery which can be recharged and hold the charges inside it. The setup consists of reference electrode, counter electrode and the test electrode. This all are connected to the electrochemical potentiometer which intern processes the data and plots it on to a graph. The setup contains an electrode for testing (test subject) reference electrode which in this case is Ag/AgCl, this is used as a reference point to calculate the potential of the test electrode as we already know the potential of the reference. Counter electrode that part of the setup which is helping in controlling the over flowing of

electrons in the system and also would help in maintaining the stability and equilibrium but with zero involvement in the potential reaction it self, then the electrolyte which is the one major part of the setup which is connection every thing together and helping in supplier in the system [8].

Figure 2.2 : Cyclic Voltammetry setup.

The figure 2.2 shows the Cyclic Voltammetry setup which was used in the project experiment it was capable of having a four electrode setup at a time and was been run by the software called origin 9 the reading was calculated using multiple scan rate and was done with multiple potential range.

2.1.3. Scanning Electron Microscope

A scanning electron microscope (SEM) is a type of electron microscope that produces images of a sample by scanning the surface with a focused beam of electrons. The electrons interact with atoms in the sample, producing various signals that contain information about the surface topography and composition of the sample. The electron beam is scanned in a raster scan pattern, and the position of the beam is combined with the intensity of the detected signal to produce an image. In the most common SEM mode, secondary electrons emitted by atoms excited by the electron beam are detected using a secondary electron detector (Everhart— Thornley detector). The number of secondary electrons that can be detected, and thus the signal intensity, depends, among other things, on specimen topography. Some SEMs can achieve resolutions better than 1 nanometer [9].

Specimens are observed in high vacuum in a conventional SEM, or in low vacuum or wet conditions in a variable pressure or environmental SEM, and at a wide range of cryogenic or elevated temperatures with specialized instruments. The signals used by a SEM to produce an image result from interactions of the electron beam with atoms at various depths within the sample. Various types of signals are produced including secondary electrons (SE), reflected or back-scattered electrons (BSE), characteristic X-rays and light (cathodoluminescence) (CL), absorbed current (specimen current) and transmitted electrons. Secondary electron detectors are standard equipment in all SEMs, but it is rare for a single machine to have detectors for all other possible signals [10].

Figure 2.3: scanning electron microscope (SEM)

The figure 2.3 shows the scanning electron microscope with the specification of the device, Resolution 3.0 nm at 30kV, Magnification Continuous from 4.5 X to 1,000,000 X, Maximum field of view 0.08um, Accelarating voltage: 200V to 30kV, Electron gun: Tungsten heated cathode, Probe current 1pA to 2uA, scanning speed: from 20ns to 10ms per pixel adjustable in steps or Continuously, Image size: up to 8,192x8,192 pixels in 32-bit quality.

2.1.4. X-Ray Diffraction

X-ray diffraction, or XRD, is a technique for analysing the atomic or molecular structure of materials. It is non-destructive, and works most effectively with materials that are wholly, or part, crystalline. The technique is often known as x-ray powder diffraction because the material being analysed typically is a finely ground down to a uniform state. Diffraction is when light bends slightly as it passes around the edge of an object or encounters an obstacle or aperture. The degree to which it occurs depends on the relative sizeof a wavelength compared to the dimensions of the obstacle or aperture it encounters.X-rays are a form of electromagnetic radiation include wavelengths measurable in nanometres (a nanometre is equivalent to one billionth of a metre) [11].

When monochromatic x-rays scatter from a substance with a structure on this scale, it causes interferences. This results in a pattern of lower and higher intensities due to constructive and destructive interferences according to Braggs law. With crystalline substances, the pattern creates three- dimensional interferences according to Braggs law. With crystalline substances, the pattern creates three- dimensional drawings of diffraction in response to x-ray wavelengths, like the spacing of planes in a crystal lattice. This process is known as constructive interference and is used as a technique for studying crystal structures and

atomic spacing. All diffraction methods start with the emission of x-rays from a cathode tube or rotating target, which is then focused at asample. By collecting the diffracted x-rays, you can analyse the sample's structure [9].

This is possible because each mineral has its unique set of d-spacings. D-spacings are thedistances between planes of atoms, which cause diffraction peaks. There are standard reference patterns of d-spacings, which act as a comparison when using XRD to identify the structure of a sample substance. Theway that x-rays reveal the atomic structure of crystals is based on Bragg's law [8].

Figure 2.4: X-ray diffraction (XRD).

The figure 2.4 shows the X- ray diffraction device with specification, X-ray generator- 3 kW, Type- Proportional and Xe-fi11ed,Window size- 24 x 20 mm^2, Linear countrate,maximum- 1.000.000 cps, Background noise, maximum- < 0.5cps, Lifetime, minimum- 1013 counts, Focus size- 0.4 mm x 12 mm (LFF).

2.1.5. Electrochemical Potentiometer

Potentiometry is one type of electrochemical analysis methods. Electrochemistry is a part of chemistry, which determines electrochemical properties of substances. An electrical circuit is required for measuring current and potential created by movement of charged particles. Galvanic cell serves as an example of such system Electrochemical cell consists of two solutions connected by a salt bridge and electrodes to form electrical circuit. Sample cell on figure 1 consists of electrolyte Metallic Zn and Cu electrodes are immersed in respective solutions. Electrodes have contacts firstly through wires connected to the voltmeter and secondly through solutions and a salt bridge, forming an electric circuit. Salt bridge consists of a tube filled with saturated salt solution (e.g. KC1 solution). Potentiometry is based on the measurement of the potentialof an electrode system (e.g. electrochemical cell). Potentiometric measurement

system consists of two electrodes called reference and indicator electrode, potentiometer and a solution of analyse [7].

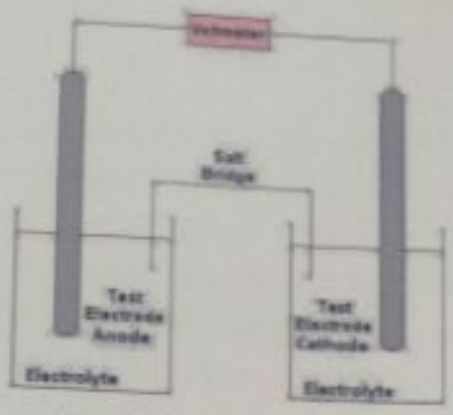


Figure 2.5 : Electrochemical Potentiometer

The figure 2.5 shows the Electrochemical Potentiometry, the setup and its components. A distant container having both test electrode in it which are inter connected by a salt bridge and then both the electrodes are connected to a voltmeter to collect the data.

CHAPTER 3

Experimental details

The processes of building a battery starts by selecting a electrode, the main objective of the paper is to use scrap metal. As a result of our research the suitable electrode for this project is found to be mild steel and brass which are used through out the nation and been sent back to scrap after their use. This metals are mainly alloys of metals such as Iron, Copper, Zinc etc. The alloy it self is not reacting to environment surrounding but when it is exposed to in the environment present of acid which will leed to decay of alloy, so to prevent this from happening we are interdicting a layer of oxide on top of the alloy. This might reduce its conductivity but would improve its protection and help to over come the decay of the electrode in acidic medium [3].

Before applying a oxide layer on top of the electrode, it has to be cleaned properly to remove all natual oxide layer with all oils and impurities on the surface by the use of three step process. First it is to scrub off all the surface particles with the help of sandpaper this will mostly remove all the oxide formad on the top and remove all impurities, then it should be cleaned using ultrasonic cleaning it is been subjected to ultrasonic vibration which will clean it farther more, then the electrode is cleaned using ethylene glycol to remove the debris on the surface, at last the electrode is kept in a strong acid for a minute or so to clean farther more. After cleaning this electrodes still they are highly reactice to the surrounding and might form a layer of oxide so cover it with plastic air tight and avoid touching the surface with bare hand to avoid the and impurities to form on it [2].

The oxidation is the next step to be followed, there are mainly two ways to obtain oxide layer chemical electrolysis or thermal oxidation. The chemical oxidation that we used was good but couldn't get a desired uniform layer formation and also couldn't control the thickness of the oxide layer formed on it and it also have to be subjected to the potential of around 40V to 50V which required a lot of setup and protection requirements which come out to be more costly, also the reaction produced a lot of dangers fumes with can he harm full if inhaled. But the other technique is a very automatic process we need a tubular furnace, this is a kink of furnace which will heat the substance in presence of air this will increase the movement of electrons in the surface leading to formation of a oxide layer as the electrons would react with the oxygen in the surrounding environment. The test subject is placed in a crucible under the condition of temprature and the time (1000^{o}C for 20min. In case mild steel and 500^{o}C for 4 hours in case of brass). this is totally a automated process as we are able to control the thickness of the oxide layer by altering the time or the temperature of the furnace [3].

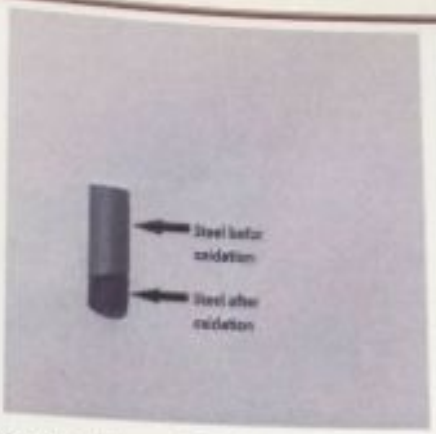


Figure 3.1: Picture of Brass with its before and after oxidation. Figure 3.2 :Picture of steel with its before and after oxidation

The figure 3.1 shows the comparison of oxidized and and un-oxidized test subjects and can be seen in the figure this subject will be used to test the metal. Result of the thermal oxidation.

Then the electrode will be subjected to testing for CV characteristics with the help of Cyclic Voltammetry setup where the electrodes capacity to store charges is been tested and then it also tells the no of cycles it will with stand, the setup also helps use to tell the voltage range under which the electrode will work will be be more efficient way with minimum decay of the electrode and with minimum current surge through the circuit [7].

The oxidized electrode is then subjected to SEM which gives us the composition of the material which is that to be determined as it is a alloy we don't know the composition or the proposition in which it is been built. And also we can absrve the atoms in the nano scale in which we can absorv the top oxide layer to see the molecule formation and its activities. Then electrode is been tested using X-ray diffraction and this well farther explain the its contains. This test subjectes are been tested and are then approved and insured to be a good electrodethen it is been studied using a elector-chemical cell this will tell us the average voltage produced by the cell itself and with this data we can design the entire battery according to ourrequirement [8].

CHAPTER 4:

Observations:

4.1 Calculation

Calculation of specific capacitance (Cp) from CV data

$$Cp = \frac{Q}{mV}$$

where Q-charge stored in coulombus

m-mass of active material in grams

V- potential

Cp- specific capacitance

As we know that,

$$I = \frac{Q}{t}$$

Or

$$Q = I \times t$$

By putting equation (2) in equation(1) we get,

$$CP = \frac{(I \times t)}{mv}$$

Dividing nominator and denominator by t,

$$Cp = \frac{(I \times t)/t}{mV/t}$$

N above equation $\frac{V}{t}$ is the scan rate of cyclic voltammetry and I will represent it by k.

$$Cp = \frac{I}{m \times k}$$

Or

$$I = Cp \times m \times k$$

Now consider CV graph

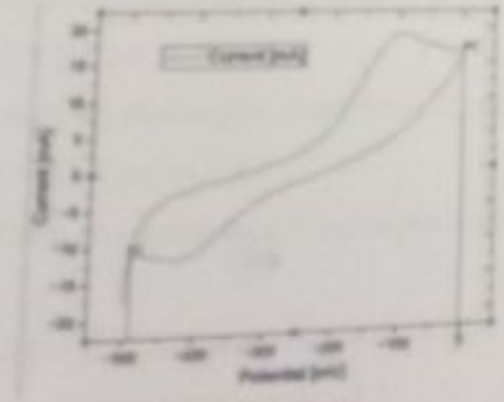


Figure 4.1 CV graph

In VC curve,the current changes by changing the potential from V1 to V2.

Therefore equation can be written in its integral form as,

$$\int_{v1}^{V2} I(v)dv = \int_{v1}^{v2} (Cp \times m \times k\ )\, dv \qquad (4).$$

If we look carefully to above equation ,the integral on left hanf side.

$\int_{v1}^{v2} I(v)dv$ =Area] represent the area of the CV curve.

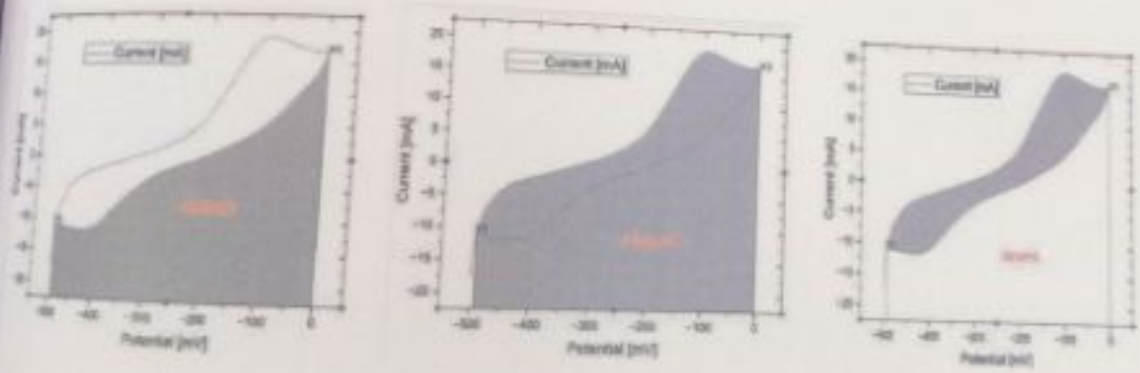
Therefore ,equation(4)Can be written as.

$$Area = \int_{v1}^{v2} (Cp \times m \times k\ )\, dv \qquad (5).$$

For a specific material ,the value of Cp,m,and k is constant,Therefore ,the integralin the equation(5) can be solved as,

$$Area=(V2-V1)\ Cp\times m \times k \qquad (6).$$

In CV curve have 3 areas,



When capacitor is charging ,then Area=A1 and equation(6)can be written as

$$A1=(V2-V1)\ Cp\times m \times k \qquad (7).$$

Similarly, When capacitor is discharging ,then Area=A2 and equation(6) can be written as

$$A2=(V1-V2)\ Cp\times m \times k \qquad (8).$$

For the calculation of area (A) inside the CV curve ,we have to subtract equation (8) from equation(7).

$$A=A1-A2$$

$$A=[(V2-V1)\ Cp\times m \times k\ ]-[(V1-V2)\ Cp\times m \times k\ ]$$

$A=[(V2-V1)\,Cp\times m\times k]+[(V2-V1)\,Cp\times m\times k]$

$A=2[(V2-V1)\,Cp\times m\times k]$

$\frac{A}{2}=(V2-V1)\,Cp\times m\times k$

$\frac{A}{2[(V2-V1)\times m\times k]}=Cp$

Or

$Cp=\frac{A}{2[(V2-V1)\times m\times k]}$

Where

Cp is the specific capacitance

A is the area inside the CV curve

M is the mass of active material

K is the scan rate of CV

$(V2-V1)$ potential window of CV

1. Brass

1.1 Brass before oxidation

The brass is the first test subject that was been tested as before oxidation readings, the CV set up readings is been shown in the below mentioned readings as a plot and its area under this graph.

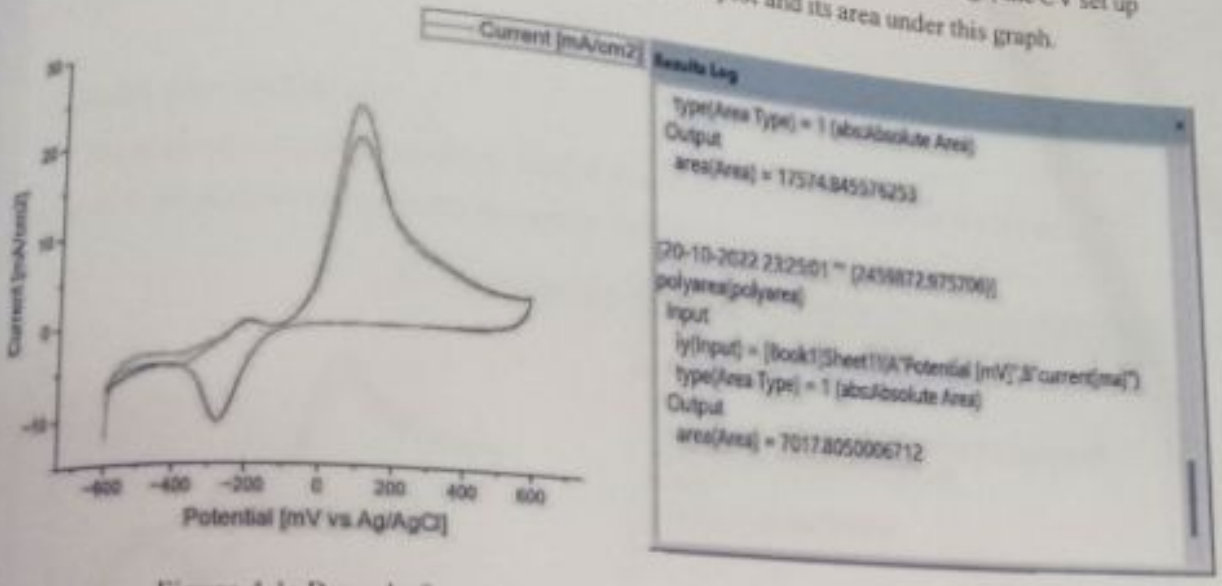


Figure 4.1: Brass before oxidation for a scanning rate of 20 cycleper second.

From figure 4.1

Scan rate =k=20mV/s

Surface mass of material=m=12.44cm ^{2}

Potential window=(V2-VI)=(-0.4V to -0.IV)

Area =17574.8455x 10 $^{-6}$ = 0.017575 unites

Cp=1.17730

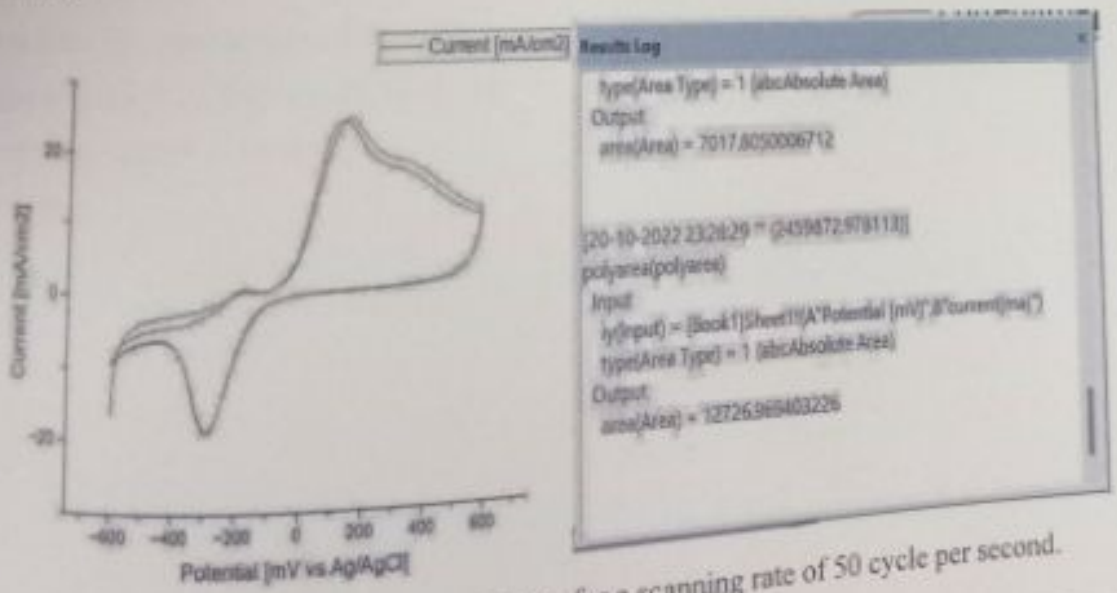


Figure 4.2: Brass before oxidation for a scanning rate of 50 cycle per second.

From figure 4.2

Scan rate =k=50mV/s

Surface mass of material=m=12.44cm ^{2}

Potential window=(V2-V1)=(-0.4V to -0.1V)

Area =7017.805x 10^{-6} = 0.070178 unites

Cp=0.189

1.2 Brass after oxidation

The brass after oxidation readings, the CV setup readings is been shown in the below mentioned in the plotand its area under this graph. And SEM image is also shown bellow

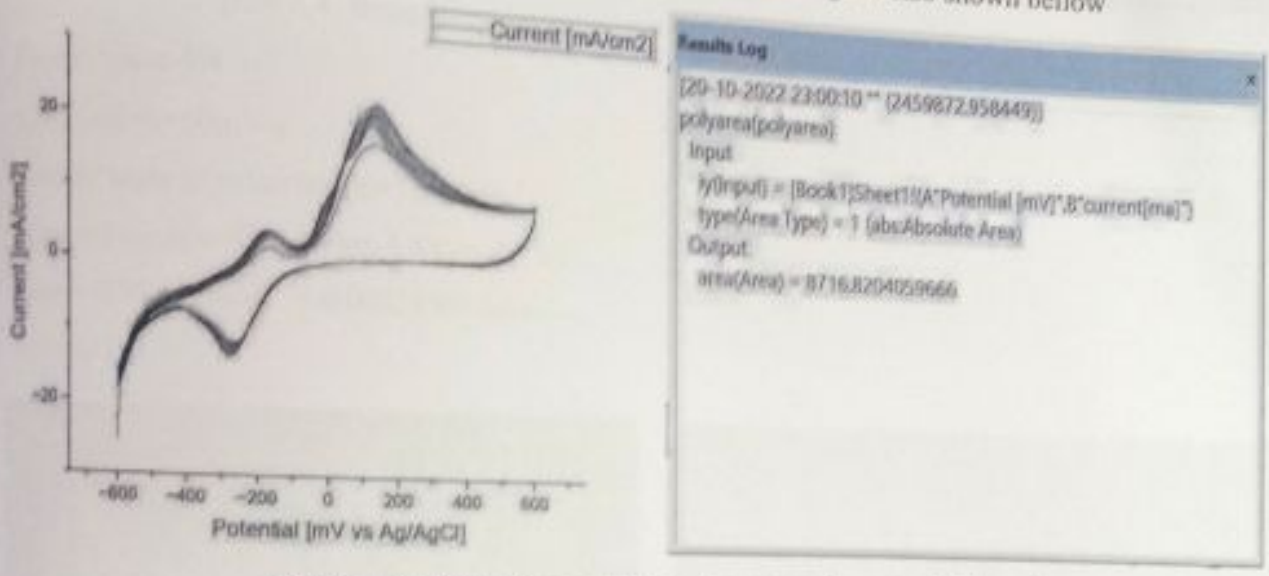


Figure 4.3: Brass aftrer oxidation for a scanning rate of 20 cycle persecond.

From figure 4.3

Scan rate =k=20mV/s

Surface mass of material=m=12.44cm ^{2}

Potential window=(V2-V1)=(-0.4V to -0.1V)

Area =8716.820x 10^{-6} = 0.008717

Cp=0.58388.

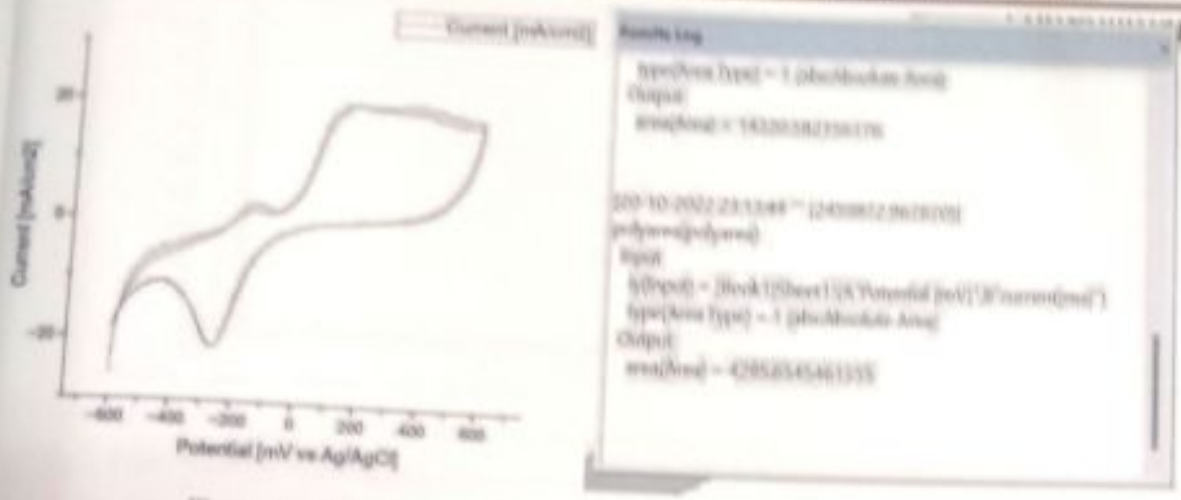


Figure 4.4: Brass after oxidation for a scanning rate of 50 cycle per second

From figure 4.4

Scan rate =k=50mV/s

Surface mass of material=m=12.44cm ^{2}

Potential window=(V2-V1)=(-0.4V to -0.1V)

Area =4295.6545x10 $^{-6}$ = 0.00429565 unites

Cp= 0.115

Figure 4.5: SEM results for Brass after oxidation

From figure 4.5 shows the micro scale and nano scale view of the surface of brass in scanning electron microscope this gives a better view of the material deposited on top of the brass

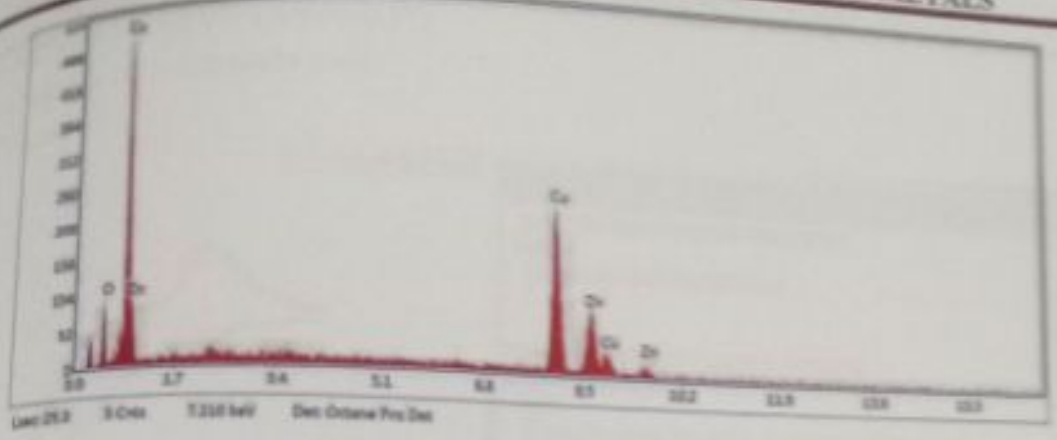


Figure 4.6: the concentration of the Brass

From figure 4.6 we can see the composition of the brass after oxidation, surface which has Cu, Zn, 0. where Cu and Zn is the metals present in brass and O is showing that oxide layer is formed.

Table 4.1: eZAF Smart Quant Results

Element	Weight %	Atomic %
OK	10.20	31.28
CuK	59.49	46.11
ZnK	30.31	22.61

1.3 Steel before oxidation

The steel readings, the CV setup readings is been shown in the below mentioned in the plot and its areaunder this graph. And SEM image is also shown bellow

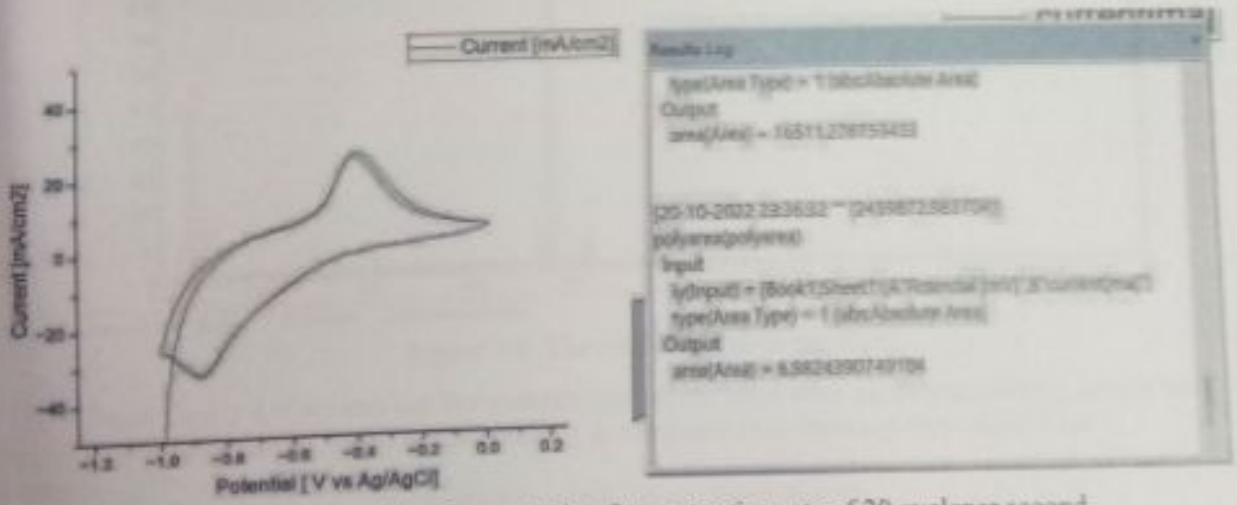


Figure 4.7: steel before oxidation for a scanning rate of 20 cycleper second.

From figure 4.7

Scanrate=k=20mV/s

Surface mass of material=m=12.905cm ^{2}

Potential window=(V2-V1)=(-0.4Vto-0.1V)

Area =6.8824x 10 ' = 0.0068824 unites

Cp= - 2.677

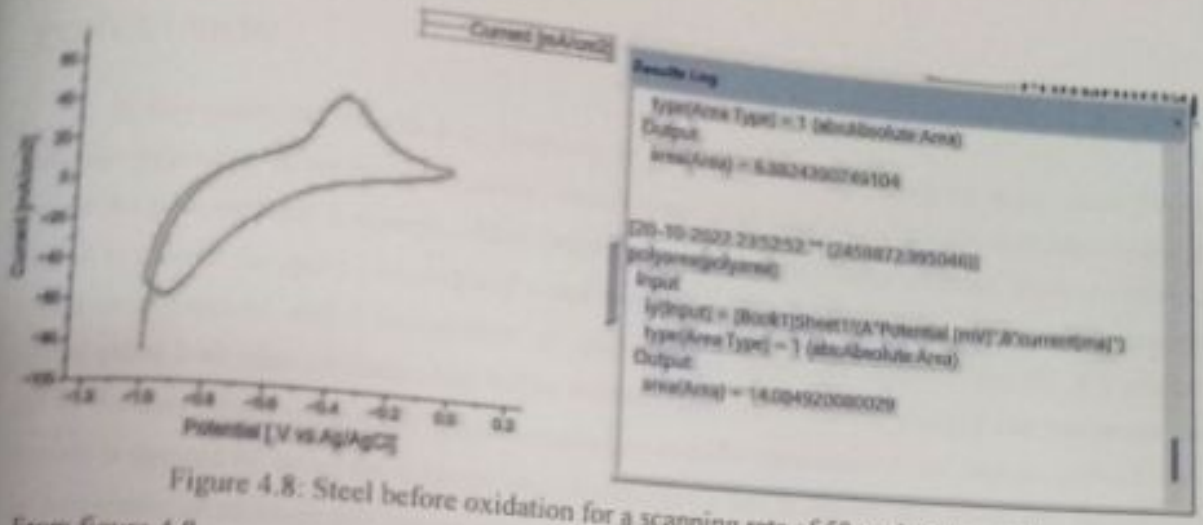


Figure 4.8: Steel before oxidation for a scanning rate of 50 cycle per second.

From figure 4.8

Scan rate =k=50mV/s

Surface mass of material =12.905c 2

Potential window=(V2-V1)=(-0.4V to-0.1V)

Area =6.8824x 10^6 = 0.0068824 unites

Cp= -5.615

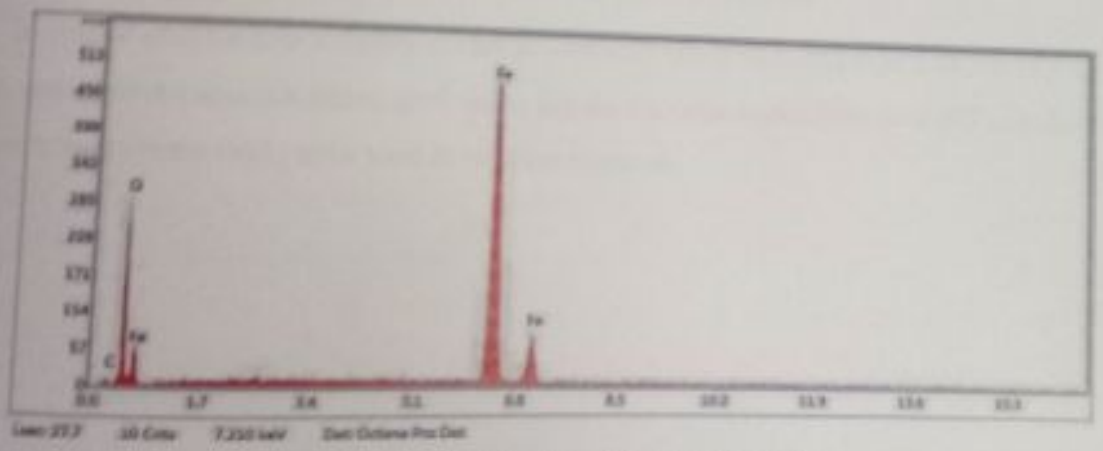


Figure 4.9: The concentration of the Steel

From figure 4.9 we can see the composition of the steel after oxidation, surface which has Fe, C, 0. where Fe and C is the metals present in steel and O is showing that oxide layer is formed.

Table 4.2: eZAF Smart Quant Results

Element	Weight %	Atomic %
C K	4.19	11.29
O K	23.03	46.56
Fe K	72.78	42.15

CHAPTER 5

CONCLUSION

In this report has provided an overview of preparing a battery using the scarp metals Different materials forpositive an negative electrodes ,various types of electrolyte and the physical implementationof battery are presented and compared . After cleaning it we oxidized using thermal oxidation method by keep it in tubular furnace . The oxidized metal is tested using SEM and XRD device, it's properties of metals ,composition, and Concentration of materials in metal are showed .By the CV graphs we plotted curve both after oxidation and before oxidation . In the it showed charged and discharged curve, and by the data which we got CV graph wecalculate specific capacitance (Cp) and we showed how the formula is derived by using the formula we calculatethe Cp and it showed that the metals are suitable for the preparation of rechargeable battery using scarp metals.

As per the graphs obtained the area under the curve of the brass at 20 scan rate before oxidation is 17574.8455x 10^{*6} unites Where as the brass after oxidation is 8716.820x 10^{*6} unites this lead to the decrease inthe Cp value from 1.17730 to 0.5838 and regarding the scan rate of 50 the area before oxidationis 7017.805x10^{*6} unites and after oxidation area is 4295.6545x10^{*6} unites with the Cp value 0.189 and 0.115 as the CP value is positive the steel can be used as positive electrode.

In case of steel the area of before oxidation with scan rate of 20 is said to be 6.8824x 10 3 unites and for scan rate of 50 the area is 6.8824x 10^{*6} unites and the Cp value respectively is -2.677 and -5.615 as the CP value is negativethe steel can be used as negative electrode.

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