Study of Thermal Resistance on Interface Materials

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Abstract– Thermal Interface Materials (TIMs) play akey role in the thermal management of microelectronics devices by providing a path of low thermal impedance between heat generating devices. TIMs provide mechanical coupling between the silicon device and the heat spreader sink. During device operation, the adhesive joint between the heat generating device and heat spreader sink is subjected to thermos mechanical stresses due to differences in thermal expansion coefficients of the silicone device and the heat spreader material. The adhesive joint can consequently de laminate the mating surfaces causing a significant increase in thermal impedance across the thermal interface material. TIMs offers improved thermal performance as well as enhanced reliability. In this present work experimentation carried out for different thickness of Bronze plates with constant loading conditions to determine the thermal resistance. Thermal resistances obtained from the experimentations concluding that the resistance for lower thickness and loading conditions are less.

Keywords*—TIM, Thermal resistances, heat transfer,* Thermocouples, surface topography

I. INTRODUCTION

The efficiency of heat transfer from heat source to the heat spreader becomes a true challenge which novel electronics technology needs to manage. Generally commercial electronic devices can generate a large amount of heat. Thus, it means that the heat dissipation technology becomes more and more significant to ensure proper operating of electronic devices. The operation of integrated circuits (IC) at elevated temperature is a major cause of failures in electronic devices and a critical problem in developing more advanced electronic packages [1]. According to Moore's law, the number of transistors that can be placed inexpensively on integrated circuits doubles approximately every two years. The thermal management in such systems is therefore an important area of research [2]. The thermal management can use convection, conduction and radiation to keep devices operating temperature in proper ranges, which ensure high reliability and proper operating parameters.

The thermal interface materials are commonly one of the best choices to meet the thermal issue requirements. The thermal interface materials basic function is to fill micro-sized surface roughness (i.e. gaps, holes, etc) between two solid materials to improve the conduction of the heat from one material to another by reducing the thermal contact resistance between them. Thermal interface materials include thermal fluids, thermal greases (pastes), resilient thermal conductors, solders (applied in the molten state), and phase change materials (PCMs, which change to the liquid state from the solid state while they are in service) [3].The major challenge in TIM testing is caused by the fact that there is a significant difference between standardized lab test data and application-specific (or 'in-situ') test results in a given set of application conditions [4-5]. Standardized test methodologies are mandatory because the user has the right to a fair comparison between various TIMs from various vendors

II. WORKING METHODOLOGY

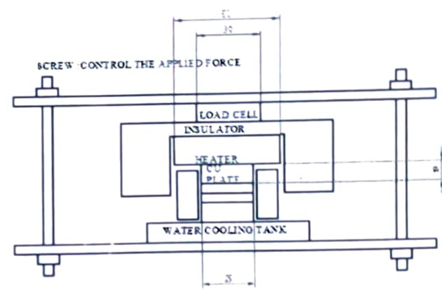

Fig 1. Experimental Setup

The apparatus comprise of three slabs of different materials of same thickness clamped on both sides using bolts and nuts. On one side of the composite wall a heater is fitted as shown in Figure 1.

Thermocouples are fitted at the interface of the plates at different points as to obtain average temperature for each surface. Heat conducted through the composite wall is taken away by circulating water on the outside of the wall whose rate of flow and an increase in temperature can be recorded.

First start the main switch, then by adjusting the dimmer knob give heat input to heater. Take the readings of all thermocouples after attaining the steady state. Make the dimmer knob to 'zero' position and then the main switch off. Repeat the procedure for different heat input.

III. RESULTS AND DISCUSSION

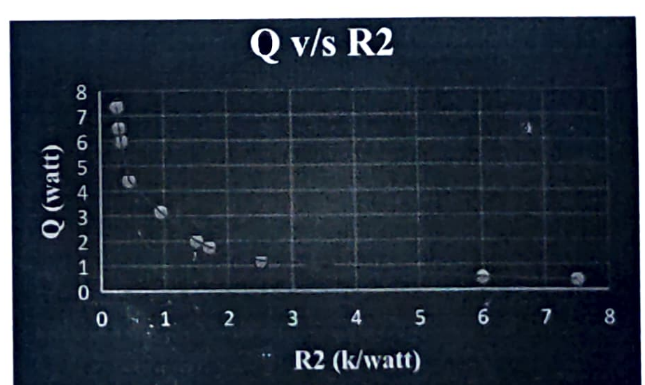

Fig 2: Heat transfer (Q) v/s Resistance (R_2)

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Assessment of Thermal Contact Resistance for Brass and Bronze Metal Alloys

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ABSTRACT: In the present work, thermal contact resistance for brass and bronze materials was investigated. Brass and bronze materials of constant thickness 0.3mm were chosen as thermal interface materials. The interfacial contact pressure was varied by application of with and without load on brass and bronze materials. Even different surface roughness conditions were produced on brass and bronze materials by using emery papers to determine the contact resistance. Extreme smooth surface finish on interface materials reduced the contact resistance. Brass and bronze materials with load reduced the thermal contact resistance to a greater extent than without load due to conformance to contacting surfaces at higher load.

Keywords: *Interfacial materials, Thermal resistances, heat transfer,* surface roughness,

INTRODUCTION

Cooling of electronic equipment is an important area for circuit design because electronic devices are generally sensitive to high temperature. Hence it is crucial to design efficient systems to remove the thermal energy dissipated in electronic equipment. Younes (2010) reported that meagre electronic devices such as transistors, capacitors, resistors, transformers, microcontroller and inductors are considered as base of the all electronic equipment. To operate meagre electronic devices electrical energy needed. During service conditions some part of energy will be loosed in the form of heat, due to inefficiency of meagre devices. Generally conventional electronic circuits are built by connecting few resistors, transistors, inductors and capacitor on a single layer printed circuit board (PCB). However these conventional circuits exhibit limited functionality. According to Deepak Gautam et.al (2014), in the present advanced technology such as D²PAK package, complex electronic circuits are built with the help of semiconductor manufacturing process.

Thermal management plays a very important role in electronics component cooling system. Chandan (2015) cited that there is an increase in the demand for cooling of electronic packages during operations. Because, due to increase in power density, the temperature of the chip increases, eventually it ruins the operation of chip. Therefore there is priority within the electronic package manufacturing industry to develop the thermal solutions for better cooling of electronic components.

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Processing and Evaluation of Microstructure & Physical Properties of Al7075 Reinforced with Cermets by Stir Casting Route

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Abstract: The combination of two or more materials with dissimilar characteristics leads to the formation of Metal matrix composites (MMC). Among MMCs large interest is being given to improve aluminium based MMCs and to develop high temperature ceramics. The present paper discusses the processing and physical properties of Al7075 reinforced with (WC-Co) cermet particulates prepared by stir casting route. An average particle size of 10μm WC-Co particulates produced by planetary ball milling process is used as reinforcement in Al7075 matrix. Microstructure evaluation of the prepared composite is carried out using SEM/EDX. Physical properties of the matrix and prepared composite are evaluated.

Keywords: Cermet, composite, ceramics, ball milling

1. Introduction

The conventional metals, alloys, ceramics and polymeric materials which are used in general engineering applications are exhibiting a less impressions in their properties in concern with the modern technology required materials which are able to exhibit an unusual contribution of properties.
To achieve the modern materials to give a combinations in the betterment of properties development of the composite materials come into the existence. Replacement for the conventional materials can be made by Metal matrix composites implementation in various applications like machine tools, connecting rod, aerofoil structures and in the field of defense. For engineering applications MMC plays a major role and aluminium is an excellent material in the non ferrous family because of its excellent properties like low density, high strength to weight ratio, high thermal and electrical conductivity and fluidity [1]. In the view of all types of MMCs aluminium matrix composites plays a major role in automobile and aerospace industries because of their good electrical and thermal conductivity, high strength and stiffness, low coefficient of thermal expansion and good wear resistance. Utilization of ceramic particles in the aluminium matrix composites are the recent field of research. The attractive combination of ceramic materials in particulate form into a metal matrix composite will result in the increment of mechanical properties which is highly difficult to extract from the monolithic materials [2]. The processing methods used in the present technology requires the knowledge about the various processing techniques and selection of proper processing methodologies for the specific materials

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ASSESSMENT OF MECHANICAL BEHAVIOUR OF HAIR FIBRE REINFORCED POLYMER COMPOSITE

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ABSTRACT

Bio-fibres have recently become eye-catching to researchers, scientists and engineersas an alternative reinforcement for FRP (fibre reinforced polymer) composite due to their low cost, fairly good mechanical properties and high aspect strength. It is estimated that, annually three to four tons of human hairfibreare wasting in India. Human hairs have solid malleable property and hence hairs could be utilized as fiber reinforcement in the polymer matrix material.Use of hair as fibrecontributes great property at easier expense of generation. Moreover, it makes ecological issue for its deteriorations because hair fibres are non-degradable in nature. In the present study, mechanical properties of human hair as reinforced polymer composites were assessed. The impact of fiber orientation on mechanical properties mainly tensile strength and hardness of composites were examined.Results exhibited significant improvement on mechanical behaviour for using human hair fibres as reinforcement inpolymer matrix composites.

Keywords:Bio-fibres, Human hair, Polymer matrix composites, Reinforcement, Mechanical behaviour

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Effect Of Injection Pressure On Performance And Emission Characteristics Of CI Engine Fuelled With Honge, Hybrid Bio-Fuel With Diesel

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3 Professor, Department of Mechanical Engineering, St. Joseph Engineering College Mangalore, 575028, India. email: rajuk@sjec.ac.in

ABSTRACT: In the present study, Honge oil, waste edible oil (WEO) and its blends with diesel were used to study the performance and emission characteristics of single cylinder 4 stroke diesel engine. The effect of fuel injection pressure on the performance parameters like brake specific fuel consumption, brake thermal efficiency and emissions characteristic were investigated at constant speed with varied fuel injection pressures. The test results show that, the Honge and waste edible oil biodiesel blends at 225 bar injection pressure exhibited best performance with low emission than at low injection pressures other than No_x. Results were also showed that performance and emissions of Honge and WEO biodiesel blends were near to diesel.

Keywords: *Injection Pressure, biodiesel, blends, Honge oil, Waste Edible oil, Emission*

INTRODUCTION

Energy plays a significant role in boosting economic growth, and the demand for fossil fuels continues to increase over the years. The depletion of world oil reserves leads to the development of bio fuels since these fuels are promising alternatives to substitute fossil fuels according to Lin et al.(2011),Dharma.et.al(2016).Biodiesel is the name of a clean burning alternative fuel, produced from domestic, renewable resources such as soybeans, sunflowers, honge,waste cooking oil, or animal fats. Bio diesel is made through a chemical process called Transesterification in which glycerine is separated from fat or vegetable oil. Nowadays, there is great interest in mixing biodiesels produced from different feedstock in order to exploit the benefits of each type of biodiesel. A number of researchers have adopted approach an implemented these fuels in diesel engines as per As per Kent Hoekman et.al(2012) ,Srithar et al. (2014) blended diesel fuel with Pongamia pinnata-mustard biodiesel at different ratios and found that there is an improvement in the physicochemical properties increase in the calorific value, specific gravity and viscosity of the blends and also found that increasing the biodiesel content of the blend results in higher brake specific fuel consumption (BSFC). However, there is a slight reduction in the carbon monoxide (CO) and carbon dioxide (CO2) emissions. As per Bora et al. (2012) investigated the characteristics of biodiesel produced by mixing three types of feedstock (polonga, koroch, and Jatropa curcas) and found that there is a significant enhancement in the physicochemical properties of the biodiesel obtained from mixed feed stocks compared to those for individual biodiesels. In the present study two biodiesel namely honge and waste edible oil methyl ester were mixed in different proportion with diesel and investigate the performance and

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Keywords: *Interfacial materials, Thermal resistances, heat transfer,* surface roughness,

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Cooling of electronic equipment is an important area for circuit design because electronic devices are generally sensitive to high temperature. Hence it is crucial to design efficient systems to remove the thermal energy dissipated in electronic equipment. Younes (2010) reported that meagre electronic devices such as transistors, capacitors, resistors, transformers, microcontroller and inductors are considered as base of the all electronic equipment. To operate meagre electronic devices electrical energy needed. During service conditions some part of energy will be loosed in the form of heat, due to inefficiency of meagre devices. Generally conventional electronic circuits are built by connecting few resistors, transistors, inductors and capacitor on a single layer printed circuit board (PCB). However these conventional circuits exhibit limited functionality. According to Deepak Gautam et.al (2014), in the present advanced technology such as D^2PAK package, complex electronic circuits are built with the help of semiconductor manufacturing process.

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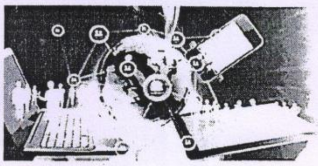

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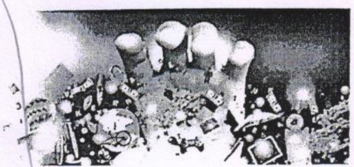

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Thermal and Performance Analysis of R600a in Vapour Compression Cycle

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Abstract— **The aim of this project is to comparatively analyze of COP using R134a & R600a Refrigerant in Domestic refrigerator at steady state condition. Two different refrigerant are R600a (Isobutene) and R134a (tetrafluoroethae). R134a is zero ozone depletion layer and high global warning and R600a is zero ozone depletion layer and negligible global warning. In domestic refrigerator was selected by the obtained result from R134a and an experiment using 170 g of R600a which indicate the similar result as R134a. Based on outcomes R600a charge amount, condenser evaporator and compressor coefficient of performance were selected for design. The analysis of variance result is indicated that R600a charge amount was the most effective parameter. At optimum condition the amount of charge is required for R600a was 170 g, 66% lower than R134a one, which not only being economic advantages, but also significantly reduces the of flammability of the hydrocarbon refrigerant. Thus in the present work comparatively analyze of COP using R134a & R600a Refrigerant in Domestic refrigerator at steady state condition. All the result were compared. Comparison of performance domestic refrigerator at steady state condition of the system was also studied. The result is indicate that R600a COP is more than R134a.CFD Analysis of condenser & evaporator also shows system effectiveness with respect to the R134a & R600a.**

I. INTRODUCTION

Refrigeration may be defined as the process of achieving and maintaining a temperature below that of the surroundings, the aim being to cool some product or space to the required temperature. One of the most important applications of refrigeration has been the preservation of perishable food products by storing them at low temperatures. Refrigeration systems are also used extensively for providing thermal comfort to human beings by means of air conditioning. Air Conditioning refers to the treatment of air so as to simultaneously control its temperature, moisture content, cleanliness, odour and circulation, as required by occupants, a process, or products in the space. The subject of refrigeration and air conditioning has evolved out of human need for food and comfort, and its history dates back to centuries. The history of refrigeration is very interesting since every aspect of it, the availability of refrigerants, the prime movers and the developments in compressors and the methods of refrigeration all are a part of it. The French scientist Roger ThÝvenot has written an excellent book on the history of refrigeration throughout the world.

II. METHODOLGY

A. Properties of R600a

Its numerical designation is R600a or Isobutane. Its chemical formula (CH3) 3 CH.

Normal boiling point = 260-264 °K at atm pressure
Critical Temperature = 135°C
Critical pressure = 3.65 MPa
Vapour pressure = 204.8 KPa at 21°C
Specific heat of liquid = 2.38 KJ/Kg°C at 25°C
Molar mass = 58.12 g mol−1
Density = 2.51 kg/m3, gas (15 °C, 1atm) 593.4 kg/m3, liquid
Melting point = -159.6 °C, 114 K, -255 °F
Boiling point = -11.7 °C, 261 K, 11 °F
Solubility in water = Insoluble
Ozone depletion potential (ODP) = 0
Global warming potential (GWP) = 3
Flash point = -83 °C, −117 °F; 190 K
Latent heat of evaporation = 362.6 KJ/Kg at atm pressure
Specific Heat Ratio C_p/C_v = 1.091(atm,25.C)
Assigned colour code = Colourless gas

B. Vapour compression cycle

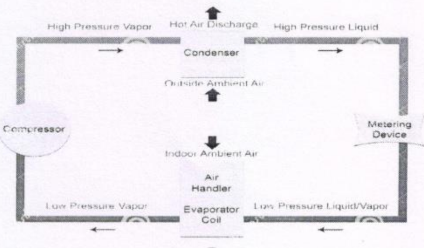

Fig 1. VCC Cycle

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Mini Review

Recent Advances on Al-Sn Alloys with Ternary Alloying Elements

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Abstract

Al-Sn alloys are preferred for bearing materials where an excellent lubricity with proper wear resistance is necessary. In the current paper, the key issues and improvements of Al-Sn-X (X=Bi, Mg, Si, Cu, Pb) alloys are outlined. Effect of ternary alloying element (X) on microstructure, mechanical and tribological properties for Al-Sn alloys are reviewed in brief. Implementation and further development of Al-Sn-X alloys are to be underway.

Keywords: Al-Sn alloy; Microstructure; Mechanical properties; Tribological properties

Mini Review

Al-Sn is an immiscible alloy and it is called as soft tribological alloy [1]. The alloy is widely used in engineering applications as antifriction and self-lubricant material. Moreover, Al-Sn alloys are considered as potential candidate lead free materials for advanced bearings in automotive and tribological applications [1,2]. The best required properties such as good conformability, friction reduction, embeddability, seizure resistance and corrosion resistance are essential to select Al-Sn alloys as engine bearing materials [2]. Sn is an important component of the alloy because it forms films preventing a seizure of Al with a steel shaft on the friction surface. Therefore, the Sn concentration in alloys should be higher and its distribution is more uniform [3]. Though, the solid solubility limit of Sn in Al is below 0.09w% Sn (0.02at%Sn) [4], it is very difficult to achieve homogeneous distribution of Sn in Al matrix [5]. This is due to, high density difference between Al (2.7g/cm3) and Sn (7.2g/cm3) metals. Moreover, there will be sedimentary tendency in the casting of Al-Sn alloy. Therefore, to improve the homogeneity of Sn phase in Al-Sn alloys, novel techniques such as physical vapor deposition, powder metallurgy, rapid solidification, severe plastic deformation, electro deposition and ternary alloying elements have been adopted by the researchers [1-6]. However, only few researchers have investigated the mechanical alloying method to produce controlled homogenous and refined microstructure in addition to adding ternary alloying elements in the immiscible Al-Sn alloy. This mini review briefly summarizes the effect of alloying element on the mechanical and tribological properties of Al-Sn alloys.

Effect of Alloying Element Addition to Al-Sn Alloys

Effect of Bi addition

Isai Rosales et al. [7] investigated the mechanical properties and tribological behavior of Bi effect on Al-Sn Alloys. Al-Sn alloys were produced by the induction melting method with different Bi additions. Compositions of alloys used were Al-Sn (1-5at%)-Bi(0.5-4at%). Researchers reported that, addition of 3.5at.% Bi exhibited increment in the plasticity of the alloys at least twice in comparison with the unalloyed sample. Significant increment in the toughness value was observed with 3.0at.% Bi with an increment of 50% compared to pure Al. Improvement of properties was attributed to the refinement of Al grains. Microstructure revealed the presence of bismuth along with Sn in the form of a continuous dispersed network along the grain boundaries of Al matrix as shown Figure 1. It was also highly recommended the use of these alloys in parts exposed to a constant friction and a moderate flexural stresses. However, addition of Bi slightly affected the tribological behavior.

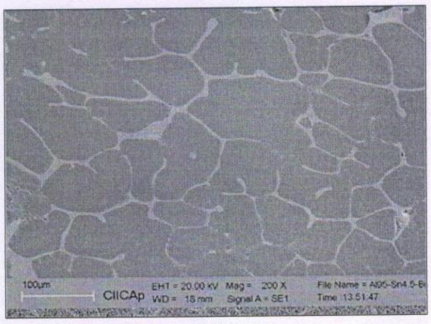

Figure 1 : Microstructure of the surface sample of the alloy with 3.5at.% Bi in annealing condition [7].

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Performance Studies on Diesel Engine Using Dairy Scum Oil Methyl Ester (DSOME)

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Abstract

The compression ignition (CI) engines are most ef icient and robust but they rely on depleting fossil fuel. Hence there is a speedy need to use alternative fuels that replaces diesel and at the same time engine should yield better performance. Accordingly, Dairy Scum oil methyl ester (DSOME) was selected as an alternative fuel to power CI engine in the study. In the irst part, this paper aims to evaluate best fuel injection timing (IT) and injector opening pressure (IOP) for the biodiesel fuels (BDF). The experimental tests showed that DSOM yielded overall better performance at IT of 27° before top dead centre (BTDC) and IOP of 240 bar. In the second part, the effect of number of holes on the performance of BDF powered CI engine was studied keeping optimized IT and IOP. An injector of ive holes with 0.3 mm ori ice diameter yields better performance when engine powered with BDF at optimized conditions.

Keywords: Dairy Scum oil methyl ester (DSOME); Number of holes; Performance

Introduction

Biodiesel is a renewable, clean burning replacement to India dependence on foreign petroleum, and creating jobs. It is prepared from a various feedstock's including animal fats [1]. The word biofuel covers a wide range of production, some of which presently commercially available and some of which are still in research and developments [2]. Biodiesel fuels burns up to 75% cleaner than diesel fuel. Biodiesel to a great extent reduces unburned hydrocarbons, carbon monoxide and particulate matters from the exhaust gas. Sulphur dioxide emissions are completely eliminated, 80% less carbon dioxide and provides a 90% reduction in cancer risks. Biodiesel helps preserve natural resources for every units of energy needed to produce biodiesel, 3.24 units of energy are gained nearly four times more than diesel [2].

India has set out plans to boost market over the next few years in an effort to strength its energy security. Fuel

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Interfacial reaction between liquid tin and solid metals

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***Abstract*: Reaction between solid Cu, Al and Stainless steel substrates and liquid tin (Sn) was evaluated. All the substrate specimens were immersed (dipped) in molten Sn for duration of 1min and 3mins at a speed of 2.5mm/s by using a motor and drawn out from the liquid tin at a speed of 2.5 mm/s. The temperature of liquid Sn maintained was 350 °C. An interfacial reaction between solid metals in liquid tin and vice versa was investigated. An increase in intermetallic layer with increasing immersion time was observed. The evolution of microstructure and formation of intermetallic compounds at the interface was assessed using metallurgical microscope.**

***Keywords*: Tin, molten, base metal, substrate, alloy, intermetallic**

1. Introduction

Soldering is a low temperature metallurgical joining method using a filler metal known as solder alloy to hold the parts to be joined together [1-3]. The reliability of solder joints is influenced by the interfacial reactions between the solders and substrates [2-5]. These reaction products are called as inter metallic compounds (IMCs). Formation of a strong bond at the solder joints is due to presence of these IMCs. In microelectronic industry especially in flip chip packaging process, package undergoes repeated reflow process, due to which IMCs grow rapidly at the solder/substrate interface [6-8].

Moreover, the type of substrate material has a significant effect on solder wettability, morphology of interfacial IMCs and integrity of solder joints. So, it is important to understand the interfacial reactions between pure Sn and the substrate metallization, especially prepared by using dipping method. Thus, the pure Sn solder is considered as a possible substitute for tin – lead alloys. In the present study effect of dipping time on reaction between solid metals in molten tin is investigated.

2. Experimental

In the current research commercially available base metals Copper (Cu), Aluminium (Al), and Stainless steel were used as substrate materials. The materials were purchased from HighTech steels, Mangalore. The materials purchased in the form of bars and sectioned into required dimensions of 50mm×30mm×3mm as shown in Figure.1.

Figure 1: Coper, Aluinium and Stainless steel substrate specimens

Effect of heat treatment on tribiological properties of Al-Sn alloy

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***Abstract*: The present study aims to investigate the effect of heat treatment on wear property of Al-15Sn alloy. The cylindrical shaped Al-Sn alloy was isothermally held in the tubular furnace at temperature of 150°C for about 30 minutes and cooled in air as well as in furnace. Cooled specimens were subjected to wear testing using pin on disc wear apparatus at a speed of 1000RPM (4kg load) and results were compared. Micro structural study was conducted to understand the effect of surface wear for the specimens cooled under different media.**

***Keywords*: Al-15Sn alloy, Heat treatment, Wear property, Micro structure**

1. Introduction

Lead (Pb) containing alloys such as white metals and Cu-Pb-Sn (lining) with Pb-based overlay plating have been extensively used as materials for internal combustion engine bearings during the last decades [1-2]. However, owing to environmental and health concerns, the use of Pb containing materials are restricted in engineering applications. In view of this, attempts are under way to develop and replace Pb-containing materials with Pb–free bearing materials [3-4].

The most common Pb-free bearing material is Al-Sn based bearing alloy. The Al–Sn based alloys, known as "soft tribological alloys", are widely used in automotive industry as sliding bearing materials for supporting the reciprocating rotation of the crankshaft in internal combustion engines owning to its excellent friction and wear properties [5-7]. A great efforts are attempting to promote the properties of Al–Sn based bearing alloys to satisfy the application requirement towards higher load and speed together with eliminating of toxic Pb [8-9].

Excellent tribological properties can be achieved in Al-Sn alloys when the soft Sn-rich phase is dispersed homogeneously into the Al matrix .However due to the low density of the aluminum alloys, in engineering applications especially where it has to perform in friction environment it is necessary to improve its mechanical and tribological properties to support different loads and provide expected performance to the alloys [8]. As is evident that only very few studies pertaining to heat treatment of Al-15Sn have been conducted so far. This work focuses on investigation of tribological properties of Al-15Sn by modifying grains through heat treatment of alloy and using different cooling media.

2. Experimental

Al-15Sn alloy ingot was purchased in the dimensions of 350mm in length and 40mm of height as shown in Figure 1. The ingot was sectioned into as per the standard specimen of wear testing using the electron discharge machine (EDM) by adopting wire radian cutting method at Bengaluru. The standard dimension is 10mm in diameter and length of 50mm as shown in Figure 2.

Rapid quenching experimental setup (tubular furnace) was used for heat treatment of samples. The set up consists of a vertical furnace for heating a standard specimen with a specimen holder and a temperature controller. The furnace is cylindrical in shape with small through hole which runs through the length of the furnace to hold the specimen from above and sudden quench from below. The dimension of the hole is 50mm in diameter and 200mm in height, the setup of tubular furnace is shown in Figure 3.

The specimens were heated to a temperature of 150°C for duration of 30mins. Two heat treated specimens were cooled in different media under two different conditions. Firstly specimens was cooled in atmospheric air and secondly cooled within the furnace. Further results are compared with as-received cylindrical specimen.