"Corrosion Protection of Mild Steel by applying TiO_2 Nanoparticle Coating via Sol-Gel Method"

Shivani Gortekar (110911009) Mayuri Mitkari (110911059)

Guide:-Dr. S. T. Vagge

Abstract

TiO2 nanoparticle coatings possess good thermal and electrical properties and they are resistant to oxidation, corrosion, erosion and wear in high temperature environments. This property is very important factor in the applications such as pipelines, castings and automotive industry. In this investigation a TiO2 nanoparticle coating has been applied on mild steel, using sol-gel method. The coating was deposited on mild steel substrate by manual dip coating technique. The morphology and structure of the coating were analyzed using SEM, EDS, XRF. For heat treatment of the coated sample, the temperature range was 3500C to 4500C to obtain good coating. The anticorrosion performances of the coating have been evaluated by using electrochemical techniques. The Tafel polarization measurements provide an explanation to the increased resistance of TiO2 nanoparticle coated mild steel against corrosion and Icorr was decreased.We found that double coated sample with dipping rate 20cm/min had maximum TiO2 coating thickness 214.2nm and maximum polarization resistance 358.2Ω ,minimum corrosion rate 3.081 mpy. But, the obtained coating had poor adhesion.Adherence of coating in sol-gel process has physical nature and depends on defects of surface, therefore adherence of coating decreases when thickness of coating grow up and also brittle ability of TiO2 nanoparticle coating will increase.

Study of Tin oxide nanocoatings prepared by spray pyrolysis for corrosion protection of steel

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Name of the Guide :Dr. S.T Vagge

Abstract

The aim of the work is to report the corrosion protection aspects of nanosized Tin Oxide coating on Mild Steel in 3.5% NaCl solution by Electrochemical Impedance Spectroscopy. Spray Pyrolysis technique was used for the coating purpose. Pure Tin oxide, 5 % Iron doped Tin oxide and 5 % Indium doped Tin oxide were deposited on the steel substrate. The films were characterized by X-ray diffraction which confirmed the composition of the coatings and Scanning Electron Microscopy which shows the homogeneity and amount of porosity in the coating. The corrosion rate is found to decrease from 8 mpy for bare steel to 3.48 mpy for pure SnO2 coating. Also, the corrosion rate is found to decrease to 7.27 mpy for Indium doped SnO2 coating and 6.03 mpy for Iron doped SnO2 coating. The results presented are the evidence of the influence of Tin oxide coatings on corrosion protection of Mild Steel. Electrochemical Impedance Spectroscopy and Potentiodynamic Polarization studies confirmed that the samples with Pure Tin oxide coating is most resistant to corrosion when compared with doped coatings.

ECAP on wrought aluminium

Prachiti G Sewalkar (110911057)

Nikita P. Mohite (110911082)

Name of the Guide : Prof. V.S.Galphade

Abstract

To enhance the strength of the material,cold deformation and hot deformation techniques such as rolling, extrusion, forging etc are used. The use of this process is limited due to the change in the dimensions of the sample. To overcome this, Severe Plastic Deformation (SPD) techniques are used which do not change the dimensions of the samples.

In this project, Equal Channel Angular Process (ECAP) which is one of the SPD's processes is studied. The study includes design and fabrication of ECAP die for wrought Al. Various test were carried out on ECAP die and the samples were studied.

Also, during this study deformation properties of Al under compression were studied at different strain rate.

EFFECTS OF DIFFERENT PARAMETERS ON Cu-Zn-Al SHAPE MEMORY ALLOY

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PALVE VRUSHALI BAPUSAHEB (110911036)

Guide: Prof N. R. ANAND

Abstract

Shape Memory Alloys (SMA) are group of metallic materials that demonstrate the ability to return to some previously defined shape or size when subjected to the appropriate thermal procedure.A shape memory alloy may be further defined as one that yields a thermoelastic martensite. The alloy undergoes a martensitic transformation of a type that allows the alloy to be deformed by a twinning mechanism below the transformation temperature.The deformation is then reversed when the twinned structure reverts upon heating to the parent phase.

These alloys are used in cell phone antennas, miniature actuators, medial stints, steam valves, thermostats, antiscald devices, airplanes, pipe couplings, etc.

In this study powder metallurgical route was used to manufacture Cu-Zn-Al Shape Memory alloy. Parameters like milling time, compaction pressure and quenching rate were varied. DTA/DSC analysis, Phase analysis, Hardness and density calculations of the samples were done. Effect of different parameters on

Development of a process for Structural Transition Al-Fe Bimetallic Material”

Reshma Kharade Jayshree Kharapkar

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Guide:- PROF. V.S. GALPHADE

Abstract

Within the last years there was a rising interest in dissimilar metal combinations. In automotive industry there is persistently growing interest in replacing the current generation brake disc made in grey iron with 45-60 % lighter Aluminium.The main reasons for introducing lighter brake disc are weight reduction , fuel efficiency , reduction of internal forces. Bimetal of cast iron and Al is produce to provide standard wear properties and to reduce weight. They can bewelded , joined by other techniques. The production of bimetallic joint is limited due to production brittle intermetallic compound in joint area and by generation of stress cause by differential thermal expansion and contraction.[1]

The aim of this project is to develop a process to make bimetallic joint between cast iron and Aluminium. The approach is to make iron rich intermetallics at the joint by casting method

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CRYOMILLING OF METALS

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Name of the Guide:

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Abstract

The advantages of cryomilled samples are extremely fine sized carbides in the matrix. The strength obtained is very high in such cases. The Cryomilling require more time for the attrition of brittle high speed steel(hss). Hence time of attrition should be increased. Logically comes the proper packaging and insulation of the attritor mill. As initially the agglomeration of particles takes place due the incubation time required for the mill to get cooled. Porosity is also a very important factor such powdered samples. Initially there is appreciable porosity present in the compacts the sintering temperature must be very high.

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FABRICATION AND PROPERTIES OF PPS/SWCNT NANOCOMPOSITE MADE BY BALL MILLING AND SOLUTION MIXING METHOD

DHIRAJ RAJPUT (110911014)
LAKHAN KAMBLE (110911048)

Name of the Guide : (Dr.R.G. Goyal)

Abstract

In this study, Polyphenylene sulfide (PPS) based nanocomposites containing single-wall carbon nanotubes (CNTs) were fabricated by a ball milling and solution mixing approach. The electrical conductivities of these composites were investigated as a function of CNT content. The conductivity was found to obey a percolation-like power law with a percolation threshold above 5wt% CNT for solution mixing method. Whereas poor percolation characteristics was observed in nanocomposite made by ball milling method. The electrical conductivity of the PPS could be enhanced by eight orders of magnitude with the addition of 8wt% CNTs, suggesting the formation of a well-conducting network by the CNTs throughout the insulating polymer matrix. The resulting nanocomposites were characterized by density measurement, porosity measurement, dielectric constant, dissipation factor and electrical volume conductivity. Morphology was studied by TEM and SEM.

FABRICATION AND STUDY ON PROPERTIES OF POLYPHENYLENESULPHIDE/ SILICA NANOCOMPOSITE

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Guided by: Prof. Dr. R. K. Goyal

Abstract

This project includes fabrication of nano silica (nSiO2) reinforced PolyphenyleneSulphide (PPS) composites using solution technique and hot compression. Any defined work is not yet carried out on this topic, so we have attempted for it.The content of nano-SiO2 was varied from 0 to 30wt% in the PPS matrix.The PPS and nano-SiO2 were suspended in ethanol using sonication bath and magnetic stirrer.After proper mixing, the powder was kept for drying.Then the powder was hot compacted at 3000C and 45 MPa. The fabricated composites were analyzed by Archimedes Principle,Vickers Hardness Tester,Scanning Electron Microscope and Impedance Analyzer for density, microhardness, dispersion and dielectric constant respectively.

Density, hardness and dielectric constant of the composites increased with increasing vol% of SiO2nano particles in the matrix.The density was increasing with the vol% of filler material.Microhardness was increased from 24.96 kg/mm2 for pure PPS to 34.23 kg/mm2 for 21.6 vol% of nano SiO2.The dielectric constant was found to be increased with increasing vol% of filler material.The dissipation factor measured at 1MHz for pure PPS was 0.011 and it varies between 0.014 to 0.031 for composites containing upto 21.6 vol% of nSiO2.Based on these results it can be concluded that PPS/SiO2nano composites can be useful for electronic application.

CORROSION PROTECTION OF RCC BARS IN CONCRETE USING CONDUCTING POLYANILINE BASED PAINTS

Pratik Ghadge Nikhil Hegde

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Name of Guide: Dr P.P.Deshpande

Abstract

Conducting polyaniline based paint were applied on reinforcing steel bars in concrete and compared with performance of conventional paints. From the experiment conducted in 3.5% and 6% NaCl solutions with a constant voltage supply of 4V, it was found that current drop initially was 0.016 mA in case of epoxy , 0.016mA in conducting polyaniline based paint coating, 0.05 mA in case of the bare sample , when immersed in a 3.5% NaCl solution. After 16 days, it was increased to 0.05mA in case of epoxy coated sample, 0.026mA in case of the polyaniline coated sample, 0.92mA in case of bare sample. And when the samples were immersed in a 6% NaCl solution , current drop initially was 0.04mA in case of epoxy , 0.035mA in conducting polyaniline based paint coating, 0.095 mA in case of the bare sample. And after 16 days, it was increased to 0.072mA in case of epoxy coated sample, 0.048mA in case of the polyaniline coated sample, 0.12mA in case of bare sample. It has been found that the conducting polyaniline based paints protect reinforcing steel bars in concrete from chloride medium and their performance is better than conventional epoxy based paints in the same medium.

COMPARATIVE STUDY OF MATERIAL PROPERTIES OF CRYOTREATED SAE8620 ALLOY STEEL ANDD3 TOOL STEEL

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Batheja Sumit Vasudeo 110911004

Name of Guide: Prof. V.T.Thavale

Abstract

D3 is a high carbon-high chromium steel developed for applications requiring high resistance to wear , abrasion and resistance to heavy pressure and sudden shock such as Dies used in pharmaceutical industries for making tablets. But D3 tool steel has poor machinability and toughness hence difficult to fabricate on economic point of view . SAE 8620 steel is a low-alloy steel made of chromium, molybdenum and nickel and has good fabricability and less cost than D3.Present work focuses on Cryogenic treatment on D3 and SAE 8620 steel . Cryogenic treatment , a supplementary process to conventional heat treatment process, is the process of deep-freezing materials at sub-zero temperatures to enhance the mechanical and physical properties of materials. D-3 tool steel and SAE 8620 alloy steel has been selected as a material for cryogenic treatment. The treatments carried out for the experiment were in sequence as: Hardening, triple tempering, then cryogenic treatment at -185°C for soaking period of 16 hrs followed by soft tempering for D3 tool steel and Hardening, tempering and cryogenic treatment at -185°C for soaking period of 16 hrs followed by soft tempering for SAE 8620 alloy steel .the hardness ,wear rate and impact energy of conventionally and cryotreated samples is measured by using Rockwell hardness tester ,pin on disc wear machine and digital charpy impact testing machine respectively .Microstructures of samples are analysed by SEM . It is observed that cryotreated samples shows improvement in hardness, impact energy and wear resistance.

EFFECT OF COOLING RATE ON EUTECTIC CELL COUNT & PROPERTIES OF GRAY CAST IRON

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Guide – Prof. V.S.Galphade.

Abstract

The present work is focused on the effect of cooling rate on gray cast iron properties & ECC. The solidification of hypoeutectic gray iron starts with nucleation and growth of primary austenite followed by nucleation and growth of a eutectic containing graphite and eutectic austenite. During their growth the composition of the residual melt around them change, because of segregation and when the eutectic composition is reached the eutectic solidification starts. This involves nucleation and growth of graphite and eutectic austenite, and together they form eutectic cells which are the cooperative growth of graphite flakes and austenite.

The microstructure, in turn, affects the properties e.g. a larger number of eutectic cells is associated with higher strength. The microstructure and nucleation of eutectic cells are normally controlled by inoculation practice and cooling rate. This microstructure was investigated using an etching technique with stead reagent to reveal the eutectic cells. The number of eutectic cells versus eutectic cell size show two distinct behaviors depending on whether being fast cooled or slow cooled. Fast cooling results in decrease in eutectic cell size and increase number of eutectic cell, while slow cooling increase cell size and decrease total number of cell. The cell count is measured by applying Saltykov formula.

PARAMETER OPTIMIZATION FOR FRICTION STIR SPOT WELDING OF STEEL SHEETS

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KARANDE PRADNYIL SRANJAY (110911043)

Prof. Dr. M. J. RATHOD

Abstract

The process of FSSW is a relatively new solid state joining process which is gaining popularity in the automotive industry. It is mostly used to weld aluminium alloys used in the body panels and the space frames in the automobile bodies. The main reason for the popularity of the process is the very high energy saving which can be achieved by the use of this joining method.

In this study based on FSSW, the welding of mild steel sheets of thickness 1mm in lap configurations was studied. Parameters like tool rotation speed, plunge depth, dwell time and feed rate were varied. Samples welded at different conditions were tested for tensile shear strength, cross tensile strength, hardness and microstructure. Properties of the welded samples were within accepted limits. And finally parameter optimization for FSSW was done using statistical tools. Another objective of this study is to set up a functional FSSW kit so that further research can be conducted in the field.

Study of Sub-zero Treatment on mechanical and wear properties of medium carbon micro alloyed steel

Akshay Dattatray Kulkarni (110911030)
SandeshSudhakarGokanwar (110911010)

Dr. N.B. Dhokey

Abstract

Cryogenic treatment of high speed steel is commonly used as an add-on treatment to conventional hardening and triple tempering treatment. This kind of treatment has been reported to improve the wear resistance of high speed tool steel. The improvement in wear property is attributed to the microstructural changes due to cryotreatment. But in case of Microalloyed steel, this treatment is not generally used to improve mechanical and wear properties. In the present investigation, one group of specimens of medium carbon Microalloyed steel was normalised (N) at 980 0C and other group was hardened (H) at 980 0C and then both groups were cryogenic treated (C) at -185 0C for varying soaking times ranging from 0 to 24 hours followed by soft tempering (T) at 100 0C and 150 0C respectively for N and H for 1 hour. The treated specimens with varying cryosoaking time were observed for microstructural changes using optical microscopy. HCT 24 specimen shows tensile strength of around 1600 MPa which was higher than any NCT specimen. Hardness of HCT specimens was higher than NCT specimens with increasing trends. But exact correlation between wear behavior and cryosoaking time could not be found out. Possibility of carbides at the grain boundaries was seen by Optical microscope.

CONDUCTING POLYANILINE –NANO TiO_2 BASED PAINTS FOR CORROSION PROTECTION OF LOW CARBON STEEL

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Name of the Guide: Dr. P.P. Deshpande

Abstract

Corrosion protection performance of polyaniline-TiO_2 nanocomposite paint on low carbon steel in 3.5% NaCl solution were evaluated by electrochemical impedance spectroscopy and potentiodynamic polarization. The corrosion rate is found to decrease from 5 mpy for bare low carbon steel to 1.83 mpy for polyaniline – nano TiO_2 based paint coating on low carbon steel. The results presented are the evidence of the influence of polyaniline – nano TiO_2 based paint coating on anticorrosion properties of both undamaged and damaged coating systems. Coating resistance value (Rc) for undamaged sample is decreased from 792.78 ohms to 136.98 ohms up to 48 hours of immersion and subsequently increased to 507.9 ohms up to 192 hours of immersion. Coating resistance value (Rc) for damaged sample is decreased from 540 ohms to 98.16 ohms up to 48 hours of immersion and subsequently increased to 164.5 ohms up to 192 hours of immersion. Increasing values of coating resistance with period of exposure indicate high protective nature of polyaniline – nano TiO_2 coating on low carbon steel.

ENHANCING THE KINETICS OF MILL SCALE REDUCTION: AN ECO-FRIENDLY APPROACH

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Abstract

Solid Wastes generated by integrated iron and steel works cause environmental pollution and therefore must be discarded accordingly. Extensive research is being conducted for the recovery and elimination of iron oxide that these wastes contain. The production of iron powder from these wastes could be considered as a method of beneficiation. In this study, the reduction of powdered and blended mill scale from rolling mill has been studied using hydrogen gas as the reducing agent based on the results of previous study which used carbon, hydrogen and a mixture of carbon and hydrogen as the reducing agents. A thermodynamic study has been done on the reactions involved in the reduction process. Early experimentation results gave 84.89% efficiency in the reduction of blended mill scale powder by hydrogen gas and this study focuses on improving the kinetics of process thereby achieving higher reducibility with the experimental variables being time, temperature and surface area of the mill scale powder exposed to hydrogen gas. The mill scale sample was powdered and blended in laboratory ball mill and thereafter residual stresses were induced in the powdered mill scale sample using additional planetary ball milling. A tubular furnace was used for the reduction purpose and hydrogen gas was supplied as a reducing agent in an atmosphere of nitrogen and the Grinstling-Brounstein and Vantoff Equation model was used for studying the kinetics of the process. The planetary ball milling helped to achieve a particle size of 5 μm and the reduction reactions were carried out in two different routes. In one, the temperature was varied and time was varied in the second route. The reduction results have yielded a maximum efficiency of 90%. Compressibility of the powdered has been studied using several concepts of sintering and powder metallurgy

CORROSION PROTECTION OF RCC BARS IN CONCRETE USING CONDUCTING POLYANILINE BASED PAINTS

GHADAGE PRATIK K. (110911008)

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NAME OF GUIDE: Dr. P.P. DESHPANDE

ABSTRACT

Conducting polyaniline based paint were applied on reinforcing steel bars in concrete and compared with performance of conventional paints. From the experiment conducted in 3.5% and 6% NaCl solutions with a constant voltage supply of 4V, it was found that current drop initially was 0.016 mA in case of epoxy , 0.016mA in conducting polyaniline based paint coating, 0.05 mA in case of the bare sample , when immersed in a 3.5% NaCl solution. After 16 days, it was increased to 0.05mA in case of epoxy coated sample, 0.026mA in case of the polyaniline coated sample, 0.92mA in case of bare sample. And when the samples were immersed in a 6% NaCl solution , current drop initially was 0.04mA in case of epoxy , 0.035mA in conducting polyaniline based paint coating, 0.095 mA in case of the bare sample. And after 16 days, it was increased to 0.072mA in case of epoxy coated sample, 0.048mA in case of the polyaniline coated sample, 0.12mA in case of bare sample. It has been found that the conducting polyaniline based paints protect reinforcing steel bars in concrete from chloride medium and their performance is better than conventional epoxy based paints in the same medium.

Friction Stir Welding of Al 6061 Alloy

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Abstract

Welding of aluminium alloy by friction stir welding is difficult. Hence solid state welding like friction stir welding is carried out. In this work the FSW of Al6061 which is wrought precipitation hardenable alloy was conducted by varying the parameter like spindle speed, feed rate, etc. Also during friction stir welding the effect of simultaneous cooling with water was performed. To study effect of microstructure and mechanical properties such hardness, tensile strength, Impact toughness.

It was found that the welded joint has soften at the centre than the base metal, because of thermal effect the recrystallization is take place. The tensile strength ranged formed135MPa to 300MMa. It was found that the value of impact toughness and tensile strength water cooled weld is smaller than the as welded sample

SYNTHESIS AND CHARACTERISATION OF $CaTiO_3$ BASED LEAD FREE PIEZOELECTRIC CERAMICS

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Name of the Guide : Dr. S.P. Butee

Abstract

With a growing concern about the environmental and health hazards of lead, there has been a renewed interest in developing lead-free alternatives to lead zirconate titanate (PZT), which currently dominates the market for piezoelectric materials. The present work involves the fabrication and characterisation of $CaTiO_3$ doped with Manganese, Zirconium and Tin. Further, a phase transformation from the orthorhombic to tetragonal crystal structure is also expected. Accordingly, samples containing 0-20 mol% Mn, 0-15 mol% Zr and 0-15 mol% Sn are synthesised by mechanical route and their key functional properties are being analysed. Based on this, the optimisation of the fabrication route and investigation into the most effective dopants and dopants content that could improve the piezoelectric properties of $CaTiO_3$ is in progress.

CONDUCTING POLYANILINE BASED PAINT ON ELECTRODEPOSITED CONDUCTING POLYANILINE ON STEEL

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Name of the Guide : Dr. P. P. Deshpande

Abstract

Conducting polyaniline has been successfully deposited galvanostatically on low carbon steel substrates from oxalic acid. Conducting polyaniline based paint coating was applied on electrodeposited polyaniline on low carbon steel. It has been seen that low carbon steel can be protected from corrosion in aqueous 3.5% NaCl solution by coating it with galvanostatically deposited conducting polyaniline as a primer and using conducting polyaniline paint as a top coat. The corrosion resistance of polyaniline coated steel is found to be 3-4 times greater than bare steel. The high resistance and low capacitance values even after long term immersion of coated low carbon steel samples in 3.5 wt % aqueous NaCl confirm the protective nature of deposited polyaniline – conducting polyaniline paint system. The electrochemical impedance spectroscopy and visual assessment confirms that the undamaged and damaged polyaniline coated samples are resistant to corrosion.

PACK CARBURIZING OF Ti-6Al-4V

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Name of the Guide :Dr.S S HOSMANI

Abstract

Over the last 40 years, the commercial production of titanium and its alloys has increased steadily. Whilst these materials have some very attractive properties, enabling applications in many industries, they are seldom used in mechanical engineering applications because of their poor tribological properties. This paper starts with an introduction to the titanium material and a review of the different types of surface treatment. The processes of nitriding and carburizing are among the most popular thermochemical treatments aiming at improving the surface properties of Ti-alloys. The following report consist of pack carburizing treatment on Ti-6Al-4V. The influence of the main processing parameters such as temperature, time on the microstructure and the diffusion of carbon during the processes of pack carburizing is discussed. Also based on investigations presented in the literature, the effects of pack carburizing on the microhardness of titanium alloys are analyzed.

SLIDING WEAR BEHAVIOR OF PP/MOS2 SELF-LUBRICATING COMPOSITE MATERIAL

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SANTOSH GANGADHAR DAUND (110711009)

Name of the Guide : Prof. M. G. Kulthe

Abstract

In present days Solid self-lubricants plays a vital role in reducing the friction and wear of materials. Solid lubricants are compounded in plastics to form a "Self-lubricating" or "Internally lubricated" thermoplastic composite. Generally liquid lubricants are used to reduce the wear and friction, but due to variation in operating and surrounding temperature liquid lubricants behave expansively and are not stable thermally, at lower temperature they freeze and at higher temperature they become more viscous, and when exposed to atmosphere they get contaminated easily and properties are deteriorated due to interaction of lubricant with surrounding atmosphere, hence effective lubrication is not possible in traditional method, Hence an attempt is made to develop a composite material which performs as self-lubricating and replace conventional method and sustain lubrication even at high temperature.

Solid lubricants retain their lubricity even in cases of almost complete oil loss, thus finding a use in critical applications such as aircraft engines. When MoS2 added to PP, it improves strength as well as reduces friction and performs as Self-lubricating composite coatings for high-temperature application and sustains lubricity and thermal stability in oxidizing environments.

FABRICATION AND CHARACTERIZATION OF HIGH PERFORMANCE PEEK/BN COMPOSITE AS A NEXT GENERATION PCB SUBSTRATE MATERIAL

Sarang P. Kulkarni (110911023)

Upendra K. Wanmali (110911040)

Name of the Guide : Dr. R. K. Goyal

Abstract

Dielectric and mechanical properties of new high performance polymer matrix composites based on poly(etheretherketone) (PEEK) as matrix and submicron sized Boron Nitride (BN) as reinforcement were discussed for application in electronic packaging substrates or printed circuit boards. The next generation Printed Circuit Board (PCB) materials are expected to possess a low dielectric constant values as it improves the signal transmission speed with lower attenuation of signal resulting in high operation rates. Due to the high performance rates they are required to exhibit high heat dissipation capability along with low coefficient of thermal expansion (CTE) so as to facilitate the removal of the accumulated heat for their proper operation. Polymer matrix composites based on PEEK/BN were fabricated by both Solution Mixing and Mechanical Mixing (Ball Milling) followed by hot pressing. The BN was varied from 0 to 50 wt % in the PEEK matrix. The experimental density of the composites characterized by Archimedes method was correlated with the theoretical density. The correlation assured the proper formation of composite pellets. The dielectric constant and loss factor of the composites are within the range of requirements for commercial use. The results show that the prepared PEEK/BN composites may have potential applications in electronics.

FORMULATION OF MATHEMATICAL MODEL FOR WATER ATOMIZED COPPER POWDER USING DIMENSIONAL ANALYSIS APPROACH

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Ujjwal C. Chaudhari2 (110911017)

Name of the Guide: (**Dr. N. B. Dhokey)**

Abstract

Water atomization can be used to produce wide range of particle size, shape and particle size distribution of metal powder efficiently by varying operating variables which include design parameters, process parameters and thermophysical properties of metal and water. Liquid copper was water atomized in a laboratory fabricated atomizer. Few experiments were conducted to produce copper powder by varying water jet pressure. In the present work, mathematical model was formulated to propose a relationship between average particle size of copper powder and operating variables. This mathematical model can be used to predict particle size for different parameters.

STUDY OF FUNCTIONALLY GRADED MATERIAL (FGM) CAST BY VERTICAL CENTRIFUGAL CASTING MACHINE"

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141011094 141011095

Name of the Guide : A.M.More

Abstract

A gradual transition in the microstructure or composition can motivate the changes in the functions of the specific locations for meeting the requirements and these tailored materials are termed as functionally graded materials (FGM). Centrifugal casting has emerged as the simplest and cost effective technique for producing large size engineering components of functionally graded metal matrix composites. The present project describes the formation of different types of gradient solidification microstructures in SiC, reinforced functionally graded aluminum composites processed by centrifugal casting and correlate the microstructures with materials and processing parameters. The microstructures of an Al-SiC alloy cast centrifugally are studied. Results indicate that at optimum speed the cast has a microstructure consisting of uniformly distributed α-Al grains and fine eutectic silicon grains. The cast exhibited better wear resistance compared to the same cast prepared at different rpm. The densities and size of the reinforcements play a major role in the formation of graded microstructures, the high density particles phase such as Sic gradation towards the outer periphery and low density particles like Al form gradation towards inner periphery.

SEVERE PLASTIC DEFORMATION OF Al/Cu BY ACCUMULATIVE ROLL BONDING

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Birajdar Sandip S. (110911060)

Name of the Guide : Dr. S. S. Hosmani

Abstract

Ultrafine-grained (UFG) metal materials processed by severe plastic deformation (SPD) have attracted the great interest. This paper provides an introduction in the field of severe plastic deformation (SPD). First of all the main methods to produce SPD materials are discussed. In the following section, the mechanisms leading to the formation of fine grains are reviewed. During post-SPD thermal annealing, some micro-structural changes take place.

Later a special attention has been paid to a typical SPD technique of Accumulative Roll-Bonding (ARB). It is aimed at refining the grain structure of suitable alloys so as to increase their tensile yield strength. The process consists in rolling a couple of overlapped sheets at a given temperature and thickness reduction ratio (e.g. 50%). At suitable ARB conditions a bonding interface forms between sheets during the deformation process, due to temperature and plastic strain. The product of the first rolling cycle is cut in two similar sheets which are again overlapped and rolled again by the same procedure as the first rolling cycle. Several ARB rolling cycles can be repeated on the same work-piece.

Various literatures showing the effect of Accumulative Roll-Bonding (ARB) on the microstructures, mechanical and electrical properties of different materials have been highlighted. In this study, the accumulative roll-bonding (ARB) process will be used to reduplicate Al /Cu alloy and then made thinner and longer by multi-rolling. Stacks with different layers will then be created and annealed at 540^0 C for 4 h. Optical microscopy will be used for the observation of the microstructures. The X-ray diffraction (XRD) pattern, micro-hardness, electrical conductivity and Electron Probe Micro Analysis (EPMA) of the alloy will be studied.

Synthesis and characterization of reinforced TiB_2 in Al matrix by oxide reduction method (TiO_2, B_2O_3)

KARADAGE ROHIT A. (141011089)

HILAGE VINAYAK M. (141011091)

Name of the Guide - Mrs. S. U. Dangrikar

Abstract

The project investigates the formation of in situ TiB_2 via a chemical among Al, TiO_2& B_2O_3. The formation of TiB_2 through two stages, namely reduction of Ti & B from their oxides followed by formation of TiB_2.As holding time of melt after reduction reaction increases, the amount of TiB_2 in melt increases and composite yield decreases due to dross formation. Mechanical property such as micro hardness increased as amount of TiB_2 in specimens increased.

XRD analysis shown that minimum time required for completion of reduction reaction should be greater than 40minute.Spectroscopy analysis shown that transfer efficiency of Ti & B in melt increases as holding time increases

Wear and Erosion studies for Gun Barrel Applicatio

Anuja P. Joshi Apurva Jogi

(110911051) (110911076)

Name of the Guide: (Prof. N. R. Anand)

Abstract

The erosion of the gun barrel is a very complex interdisciplinary problem involving several branches of engineering and science. Wear/erosion causes increase in bore diameter at the commencement of rifling. Initially, the bore of gun barrel were coated with electroplated chromium to provide both erosion protection and long service life. But for two primary reasons the chrome coating is insufficient for continued use. First, hexavalent chromium chemistry as used in chrome plating operations is toxic, and a federal mandate to eliminate chrome-VI requires a replacement. Secondly, the current state-of-the-art gun propellants are not especially compatible with the properties of a chrome-plated gun tube surface, and therefore the lifespan of current gun tubes is short enough to warrant an intensive search for a chrome replacement material. For the past 80 years, there has been no viable alternative due to the extreme nature of the interior ballistic environment and utilization of aggressive munitions that expose the gun barrel to elevated flame temperatures and erosive gases. The objective of this project is to demonstrate the suitability of refractory metal alloy coating for the bore protection of gun barrel as a replacement for chromium (Cr(VI)) in the production of cannon barrels.

Synthesis and characterization of sodium beta alumina nano powders by sol-gel process.

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Abstract

Sodium beta-alumina electro-ceramic can act as an efficient solid conducting electrolyte because of its fast ionic conductivity offer due to its unique structure, in which two-dimensional conduction planes partially occupied by Na^+ ions are separated by crystalline Al_2O_3 spinel block. Amongst the various processing routes available, Sol-Gel processing route being more energy efficient, offering better composition control and product homogeneity, also leading to synthesis of β″- alumina in purest form was used so as to cover all the attributes of synthesizing perfect solid electrolyte. Sodium beta-alumina (SBA) nano-powders were synthesized by the citrate sol-gel process, and the effects of the cationic surfactant n-cetyltrimethylammonium bromide surfactant (CTAB) were investigated. The nano-powder thus obtained was compacted uniaxially at 100MPa and sintered at 1400^oC for 2 hours. The structure and morphology of the nano-powders were characterized by X-ray diffraction (XRD) and transmission electron microscope (TEM) techniques, respectively. The effects of CTAB on the citrate sol-gel process and the SBA formation were investigated by thermo gravimetric/differential thermal analysis (TG/DTA).The results showed that the CTAB inhibited the agglomeration of SBA powders effectively and consequently decreased the crystallization temperature of SBA, about 150 °C lower than that of the sample without CTAB. Average crystallite size of nano-powders synthesized without and with CTAB ranges from 30-40nm.

LASER WELDING OF ALUMINIUM ALLOY AA5052

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Abstract

Laser beam welding is an attractive welding process for Aluminium alloys, because its low heat input minimizes the width of weld fusion and heat affected zones (HAZ). In the present work, bead on plate and autogenous butt welding was carried out on non-heat treatable Aluminium alloy AA 5052. An industrial CO_2 laser with maximum output of 4 kW was used to weld 1.2 and 3.2 mm thickness plates with powers 1-3 kW and at speeds of 1-5 m/min. Macrostructural characterization of bead on plate welds has shown the full penetration for 3.2 mm thick plate at 3 kW and 3 m/min while 3 kW and 5 m/min for 1.2 mm plate. Butt welding was performed with powers 2-3.0 kW and welding speeds of 2-3.5 m/min for 3.2 mm thickness plate whereas 1.2 mm thickness plates were butt welded using 0.25-2 kW powers and speeds 3- 5 m/min.

It was found that HAZ width varied between 1-1.5 mm. HAZ indicated a remarkable softening due to coarsening of grain structure. Slightly higher depth of penetration was observed in bead-on-plate welds having surface coated with graphite due to increased absorptivity of aluminium alloy. It was also observed that increasing the welding speed decreases the bead width of bead-on-plate welds. Micro-hardness measurements and tensile test were carried out for 3.2 mm butt welds. 1.2 mm plates butt joints did not show appreciable strength whereas for 3.2 mm butt welds tensile strength was in the range of 60-94 MPa which was very much less as compared to the strength of base metal. Post weld heat treatment at 200ºC for 1-8 hours did not show any variation in the hardness and tensile strength.

STUDY OF MAGNETIC PROPERTIES OF Fe-Al INTERMETALLICS

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Abstract

Fe-Al intermetallics with various Al wt% were prepared and studied for magnetic and physical - chemical properties. Experimental values were found to be good agreement with the standard values of Fe-Al intermetallics. The intermetallics are useful in structural, agricultural, and automobile applications.

In this project, Fe-Al intermetallic was prepared with three varying Al wt% by powder metallurgy route by self-prorogating high-temperature synthesis (SHS)at 660°C. Sintering of a powder compact is done 1200°C. The composition of Fe-Al intermetallic were prepared at 10, 30 and 40 at.% of Al in balanced Fe. The prepared FeAl intermetallic samples were characterized to get the information about the topography, density, and most important the magnetic properties. SEM showed some uniform dispersion of Fe-Al intermetallic in some phases with some standard results. Some aggregates of Fe-Al with different morphology were seen with different Al at%. Experimental density was changed with the standard one due to some change in the volume and densification in the synthesis process. EDAX examination showed especially coarsed grain in the powder sample had varying phase composition, as, bigger grain rich in Fe as compared to the small grains. Mossbauer showed the change in the magnetic properties with varying at% Al , as , disordered was seen to be ferromagnetic and ordered with higher than 30 at% Al as total paramagnetic and the was a transition in between this at% Al range.

EVALUATION OF POTASSIUM ZINC MOLYBDENUM PHOSPHATE AS ANTICORROSIVE PIGMENT IN EPOXY COATING

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Abstract

Corrosion, being an electrochemical phenomenon, can be tackled through the use of electrochemistry and conducting polymers. Numbers of researchers have evaluated corrosion performance of Potassium Zinc Molybdenum Phosphate in Epoxy coatings. This report contains study of important recent papers in this area. The papers indicate the better corrosion inhibitive performance of Potassium Zinc Molybdenum Phosphate. Potassium Zinc Molybdenum Phosphate can be used with all types of binders. When added to resins it improves both the drying and the adhesion to the metal substrate. The work will be undertaken to synthesize Potassium Zinc Molybdenum Phosphate based paint, to evaluate the performance of this paint in Epoxy coatings against corrosion of low carbon steel in aqueous 3.5 % NaCl by electrochemical methods, to understand corrosion protection mechanism and to optimize the properties if any.

SYNTHESIS AND STABALISATION OF PROCESS CONDITIONS FOR 'β-$FeSi_2$'

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Abstract

Thermoelectric β-$FeSi_2$ is a promising material for high temperature systems wherein heat energy can be usefully converted to electrical energy. $FeSi_2$ powders have been produced by mechanical alloying process and consolidated by isothermal annealing.In the proposed work, the planetary milling time was varied at equal internals and then powders were compacted at 500 MPa to form pallet of 16 mm diameter and 4 mm height followed by sintering in an inert atmosphere at 890°C for three different varying times 0.5h, 1 h and 1.5 h. The influence of milling time, type and sintering conditions on alloying progress was studied by Laser particle size analysis, X-ray diffraction, SEM and Differential thermal analysis for the evolving phases.As-milled powders were of metastable state and transformed to β-$FeSi_2$phase by subsequent isothermal annealing. However, as-consolidated iron silicides from planetary ball milling consisted of large amount ofε-FeSi phase while very low transformation was observed in low energy ball milling. DTA revealed the transformation temperature to be around 800 °C.