ScienceDirect

Materials Today: Proceedings

Volume 33, Part 7, 2020, Pages 3449-3453

Investigation on the tribological properties of copper alloy reinforced with Gr/Zro_2 particulates by stir casting route

Zeeshan Ali [a], V. Muthuraman [b], P Rathnakumar [a], P. Gurusamy [c], Madeva Nagaral [d]

Show more

Share Cite

https://doi.org/10.1016/j.matpr.2020.05.351

Get rights and content

Referred to by Expression of concern-[Part 3]
Materials Today: Proceedings, Volume 33, Part 7, 2020, Pages A3
View PDF

Abstract

The combination of Graphite (Gr) and Nano Zirconium Oxide (ZrO_2) is found efficient in reinforcing copper matrix composites (CMC) for bearing application due to its intrinsic ultrahigh tribological and mechanical properties. In this study the wear properties of copper alloy (90% Cu and 10% Sn) composites were compared with Cu alloy + 4 wt% Gr, Cu alloy + 4 wt. %ZrO_2 and Cu alloy + 4wt. %Gr + 4 wt% ZrO_2. In the present investigation the fabrication of CMC composites were made through stir casting process. The Microstructural characterization was carried with Scanning Electron microscopy (SEM) and Electron Displacement Spectrum (EDS) to show uniform distribution of reinforcement particles in the matrix and also to confirm the elements. The wear behavior were evaluated at varying loads of1, 2 and 3 kg with a constant speed of 300 rpm and for varying sliding speeds of 100, 200 and 300 rpm and constant load of 3 kg using a pin on disc apparatus. After test on wear machine it was found that Cu alloy with graphite and ZrO2 composites at varying loads and

varying speeds exhibits the superior wear resistance. These composites are best suited for bearing applications.

Introduction

A significant number of the designing applications on the planet today require materials with common mix of properties that can't be met by the conventional metal alloys. This is particularly valid for the materials that are required for aviation and transport applications. For instance engineers are in mission for basic materials that have high strength yet Low density, Impact resistance but hard, etc. Designers around the globe have consistently been looking for better and better mix of properties in materials. Composite materials are falsely made by consolidating at least two materials which normally have unique qualities. The constituents of a composite material can be commonly recognized visibly. This is as opposed to normal metallic composites whose stages can be distinguished uniquely under higher magnification. Copper combinations are broadly utilized in an assortment of items like motors, wiring, radiators, connectors and brakes that empower and upgrade our regular day to day existences. They have amazing electrical and thermal conductivities have exceptional protection from erosion and weariness and are commonly non magnetic. They can be promptly soldered and brazed; they can be cleaned and buffed to virtually any ideal surface and shine. The normal vehicle contains 0.9 mile of copper wire, and the total entirety of copper ranges from 20 kg in small car to 45 kg in hybrid vehicles [1]. An outstanding alloying property of copper have made it significant when combined with various metals, for instance, zinc (brass), tin (bronze). These composites have desirable qualities and, depending upon their composition, are created for exceptionally particular applications such as car radiators, heat exchangers, and different applications requiring fast conduction of heat across or along a metal portion [2]. Friction and wear consistently happen at machine parts which run together. This impacts the effectiveness of machines adversely. Today, various mechanical applications use vacuum conditions. In this manner, it got fundamental to decide the tribological behavior of the machine parts running under these conditions [3].

Wear harm the materials, directly or indirectly, diminishes the service life of materials clearly. It extensively exists in the equipment of coal mining, oil and chemical etc. during their service forms. The material disappointment brought about by corrosion and wear has brought about an enormous misfortune to the national economy [4]. Corrosive wear happens when a functioning environment brings about material disintegration or produces the reaction product on either of the rubbing surfaces. There action products are normally inadequately bounded to the surface and further rubbing causes the irremovable [3]. Adhesive wear is caused by the rubbing of two surfaces. Due to high pressure the week material when it crosses the plasticity while rubbing causes the material to wear. It depends on chemical and physical properties of materials [5], [6], [7], [8], [9]. The adhesion wear is one of the most prevailing wears; it structures 15% of the mechanical wear. In the last three decades, liquid state casting routes is extensively used for manufacturing the composite materials when compared to the conventional methods. Liquid state methods are highly flexible, rapid process and highly suitable for mass production [10], [11], [12], [13], [14], [15], [16], [17], [18], [19], [20], [21], [22], [23], [24], [25], [26], [27], [28], [29], [30], [31], [32], [33], [34], [35], [36], [37], [38], [39], [40], [41], [42], [43], [44], [45], [46],

[47], [48]. In the present research copper alloy composites are developed by using graphite and ZrO_2 as reinforcements. Further, these composites are evaluated for wear studies.

Section snippets

Matrix and reinforcement particulars

Manas Metallurgical, Bangalore, given the copper and tin (Copper Alloy) as ingots and bars. Table 1 shows the copper alloy details related to composition. Mincometsal Bangalore, provided nano-powder ZrO2 and Graphite. Table 2 shows highlight the addition of reinforcement in copper alloy. Fig. 1 reveal the cast iron die used to prepare the samples.…

Fabrication of copper alloy–ZrO2 and graphite MMCs

For the manufacturing of CMC liquid metallurgy technique is used. To make it economical and for uniform distribution liquid metallurgy course of…

Microstructural analysis

Fig. 4a shows microstructure of a cast copper-10% tin alloy, Fig. 4b represents Cu-Sn-4 wt% of Gr composites, similarly Fig. 4c and d represents Cu-Sn + 4% nano ZrO2 and Cu-Sn + 4% nano ZrO_2 + 4% Gr composites. The SEM micrographs uncover practically uniform distribution of ZrO2 and Gr particulates in the matrix as observed in the Fig. 4(b–d). Consistently disseminated particulates increment the general quality and different properties decreasing the porosity of the MMC. Fig. 5(a) shows the EDS …

Conclusions

Using SEM and EDS the Microstructural analysis of the composites are carried out, SEM images reveals the uniform distribution of reinforcement in the Cu-Sn alloy, the presence of Zr and C was found in the EDS spectrum which shows the ZrO2 and Gr. The medium influenced the tribological behavior of Cu-Sn + 4% nano ZrO_2 + 4% Gr alloy considerable the friction coiffeciont was consideriable lowest due to the addition of nano ZrO2 and graphite particles allows it be more wear resistance.…

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

Special issue articles Recommended articles

References (48)

Constantinides *et al.*
Appl. Surf. Sci. (2002)

Y. Wang *et al.*
Tribol. Int. (2016)

B.N. Sarada *et al.*
Mater. Today:. Proc. (2015)

T.M. Yue *et al.*
J. Mater. Process. Technol. (1996)

A. Maleki *et al.*
Mater. Sci. Eng., A (2006)

V. Mohanavel *et al.*
Mater. Today:. Proc. (2018)

V. Mohanavel *et al.*
Mater. Today:. Proc. (2018)

V. Mohanavel *et al.*
Mater. Today:. Proc. (2020)

V. Mohanavel *et al.*
Mater. Today:. Proc. (2018)

V. Mohanavel *et al.*
Mater. Today:. Proc. (2018)

View more references

Cited by (14)

Microstructure mechanical behavior of Cu-Sn alloy reinforced with Al<inf>2</inf>o<inf>3</inf> and Graphene metal matrix composite
2023, Materials Today: Proceedings

Show abstract

Influence of aluminium oxide and graphene on the mechanical properties of Cu-Sn alloy composites

2023, Materials Today: Proceedings

Show abstract

Investigations on mechanical behaviour of nano zirconium oxide and graphite particles reinforced copper-tin alloy metal composites

2023, Materials Today: Proceedings

Show abstract

Study of the performance of Cu-Gr composite tool during EDM of AISI 1020 mild steel

2022, Materials Today: Proceedings

> *Citation Excerpt :*
>
> ...Also, it was observed that wear rate of copper electrode was seen lesser than that of brass electrode due to its higher melting point and thermal conductivity [14]. Zeeshan et al. [15] studied the tribological properties of Cu alloy + Gr/ZrO2 particles based MMC fabricated using stir casting route. The results at varying speeds and loads exhibited higher wear resistance....

Show abstract

Studies on mechanical properties of 3 wt% of 40 and 90 μm size B4C particulates reinforced A356 alloy composites

2022, Materials Today: Proceedings

> *Citation Excerpt :*
>
> ...All things considered mechanical stir casting process by the development of vortex strategy is a standout amongst other method because, it is generally economical and it tends to be utilized to scatter B4C particles in liquid aluminum in two steps stages into the liquid matrix and acquiring a decent wetting by the proper choice of parameters like blending speed, time, temperature of liquid metal [6]. Despite the fact that stir casting permits delivering segments in mass for a minimal price of creation with various complex geometries, yet there are a few drawbacks with it like porosity, blowholes [7]. Because of this the mechanical properties frequently prompts degradation....

Show abstract

Microstructure and evolution of mechanical properties of Cu-Sn alloy with graphite and nano zirconium oxide particulates

2022, Materials Today: Proceedings

> *Citation Excerpt :*

> ...From the material point of view, human culture has encountered the different Ages. Composite materials are transformed into the substitutes for conventional materials, showing upgrade performance [1]. In the fast-growing world with progression of science and innovation, materials assume an important part in the national economy as well as defense [2]....

Show abstract

View all citing articles on Scopus

View full text

© 2019 Elsevier Ltd. All rights reserved. Selection and peer-review under responsibility of the scientific committee of the International Conference on Nanotechnology: Ideas, Innovation and Industries.

ELSEVIER

All content on this site: Copyright © 2024 Elsevier B.V., its licensors, and contributors. All rights are reserved, including those for text and data mining, AI training, and similar technologies. For all open access content, the Creative Commons licensing terms apply.

RELX™