THINK INDIA JOURNAL

ISSN:0971-1260
Vol-22- Issue-14-December-2019

Mechanical Behavioural & Friction Stir Welding Studies On Copper Hybrid Metal Matrix Composite

[1] Vinod Kumar Biradar, [2] Fareen S, [3] RenukaK, [4] Mohan Kumar S, [5] Krishanamoorthy P.R
[1] *Assistant Professor,*
[2][3][4][5] *UG Scholars,*
[1][2][3][4][5] *Department of Mechanical Engg.*
[1][2][3][4][5] *Sri Sairam College of Engineering, Bangalore*

Abstract: Copper is characterized by High electrical, Thermal conductivities and Good Corrosion resistance but has low strength at room and elevated temperatures. Improvement of Mechanical properties is possible by introduction of ceramic particles realized through special manufacturing processes (squeeze or stir casting, spray forming or powder metallurgy techniques). Copper composites are used when high thermal conductivity, high absorption and dissipation of heat, high resistance to thermal fatigue and good frictional wear resistance are required.

I. INTRODUCTION

Currently the most common production method of composite materials is pressure infiltration of porous performs made of ceramic particles or fibres with molten light alloys. For this reason metal matrix composite materials based on copper and copper alloys are developed for wide range of applications like resistant welding electrodes, heat exchangers, electrical connectors and contacts.Due to good corrosion resistance, good electrical and thermal conductivity copper alloys have been recently examined as a matrix for the ceramic particles reinforced composite materials.

Ceramic Strengthening Materials like Alumina (Al_2O_3), Zirconium (ZrO_2), and Silicon dioxide (SiO_2)… are used as the reinforcement in composite materials due to its High Hardness, Toughness, Resistance to wear and Corrosion Properties are inhabited in the ceramic particles. The combination of Copper and Aluminium oxide opens up wide possibilities for applications where good wear resistance, good electrical and thermal conductivities are required.

Their properties depend on a number of factors,including the content, shape and distribution of the ceramicphase, the method of its preparation as well as the conditionsunder which they are fabricated. All these variables havestrong influence on the above mentioned characteristics and, inconsequence, on the future applications of the final material.

Copper and Copper alloys constitute one of the major groups of commercial metals. They are well-known materialsthat are widely used in industrial applications mainly because of their excellent electrical and thermal conductivities,outstanding resistance to corrosion, ease of fabrication, and good strength and fatigue resistanceCopper-based composites with hard particles are widely applied in electrical sliding contacts such as those in railway overhead current collection system, lead frame in large scale integrated-circuit, welding electrodes, transfer switches and electrical contact material. Powder metallurgy is the most applicable technology way of producing the copper-based composites, especially when the matrix material is reinforced with second phase particles.

For many applications pure Cu cannot be used because of its low strength. Therefore, improvement in the properties of copper has become essential for its applications in cutting-edge technological applications. The improvement of the mechanical properties of copper is important for its use in a larger number of fields. Composite materials offer several applications in the aerospace, automotive and ship building industries as they have certain advantages over other conventional metals. Metal matrix composites (MMCs) combine both metallic properties, such as toughness and ductility, and ceramic properties, such as elastic modulus and high strength, which endow shear strength providing service at high temperatures

Copper has high thermal conductivity and used as a structural material for cooling. In order to increase its high temperature properties, different reinforcements are being used.

II. BRIEF INTRODUCTION TO TAGUCHI METHOD

The technique of laying out the conditions of experiments involving multiple factors was first proposed by the Englishman, Sir R.A.Fisher. The method is popularly known as the factorial design of experiments. A full factorial design will identify all possible combinations for a given set of factors. Since most results usually involve a significant number of factors, full factorials design in a large number of experiments. To reduce the number of experiments to a practical level, only a small set from all the possibilities is selected. The method of selecting a limited number of experiments which

ISSN:0971-1260
Vol-22- Issue-14-December-2019

produces the most information is known as a partial fraction experiment. Although this method is well known, there are no general guidelines for its application or the analysis of the results obtained by performing the experiments. Taguchi constructed a special set of general design guidelines for factorial experiments that cover many applications.

IV. OBJECTIVE

The objective is to study Copper-based Metal Matrix Composites by a mechanicallystrengtheninghaving high strength at elevated temperatures and micro structural stability, Mechanical properties, Tribological behavior, and Friction Stir Welding Process parameters optimization (FSW), by adding the more than one ceramic particle with different proportion, which is said to be a HYBRID MMC. To improve the bonding strength of the matrix material on the ceramic particle a layer of metallic coating (Matrix) is applied to the ceramic particles, the results obtained are analyzing the data by Taguchi Technique. As Copper Composite materials show the highest potential for application in heat sinks for Electronic, Mechanical and Aerospace applications.

III. METHODOLOGY

1) As the composites consist of different ceramic material with different proportion it is said to be a HYBRID MMC.
2) To improve the bonding strength of the matrix material and the ceramic particle a layer of metallic coating (Matrix) is applied on the ceramic particles.
3) Preparation of Nickel Hybrid Metal Matrix Composites (MMC).
4) Evaluation of the Mechanical properties as per ASTM standards.
5) Evaluation of the Tribological properties as per ASTM standards.
6) Friction Stir Welding Process parameters optimization (FSW), by adding the more than one ceramic particle with different proportion, which is said to be a HYBRID MMC.

The design of an experiment methods are adopted for FSW which involves the following steps

a. Selection of independent variables
b. Selection of number of level settings for each independent variable
c. Selection of orthogonal array
d. Assigning the independent variables to each column
e.Conducting the trials

V.PROBLEM IDENTIFICATION

From the Literature survey the main problem identified towards the research is that the Copper-based Metal Matrix Composites are the Material where the cost parameter is more for the alloying materials adding to it to achieve High Mechanical strength parameters and Thermal properties. An effort is done to achieve High Mechanical strength parameters and Thermal properties at lower cost by adding naturally available ceramics like Quartz, Kyanite Andalusite Silimanite Mullite, Beryl, and so on. These materials are having more than one ceramic material with different proportion which may give a better result than that of adding one ceramic material. As the composites consist of different ceramic materials with different proportion it is said to be a HYBRID MMC. To improve the bonding strength of the matrix material and the ceramic particles a layer of metallic coating (Matrix) is applied on the ceramic particles. The main intention is to achieve the better result by using naturally available ceramic materials which are having a very high melting point.

As most of the men made (developed) ceramics are made up of two or more elements. This is called a compound. For example, alumina (Al_2O_3), is a compound made up of aluminum atoms and oxygen atoms, The atoms in ceramic materials are held together by a chemical bond. The two most common chemical bonds for ceramic materials are covalent and ionic.

For metals, the chemical bond is called the metallic bond. The bonding of atoms together is much stronger in covalent and ionic bonding than in metallic. That is why, generally speaking, metals are ductile and ceramics are brittle. In general, most ceramics are hard, wear-resistant, brittle, refractory, thermal insulators, electrical insulators, nonmagnetic, oxidation resistant, prone to thermal shock, and chemically stable. Due to its ceramic property, they are used for a multitude of applications. After fabrication as the material various Mechanical properties, Tribological behavior, and Friction Stir Welding Process parameters optimization (FSW) are conducted for the evaluation of the Hybrid Composite.

V.CONCLUSION

The possible outcome for the is to prepare the Copper Hybrid Metal Matrix Composites (MMC) the same is tested for the Mechanical, Tribological wear properties and Friction Stir Welding Process parameters optimization (FSW), Using Taguchi

ISSN:0971-1260
Vol-22- Issue-14-December-2019

Technique and hence this material may be an alternative for the MMC's. Analysis of variance (ANOVA) is employed to identify the level of importance of the Welding parameters. Finally experimental confirmation was carried out to identify the effectiveness of this proposed method.

VI. REFERENCES

1. K. Jach, K. Pietrzak, A.wajler, A.sidorowicz,U.brykała **"**application of ceramic preforms to the manufacturing of ceramic – metal composites"Volume 58 2013 Issue 4 DOI: 10.2478/amm-2013-0188
2. M. Mikuła, M. Lach, J.S. Kowalski "Copper Matrix Composites Reinforced With Volcanic Tuff"Issn 0543-5846 Metabk 54(1) 143-146 (2015)
3. AleksandarVencl, ViseslavaRajkovic, Fatima Zivic"Friction And Wear Properties Of Copper-Based Composites Reinforced With Micro- And Nano-Sized Al2O3 Particles"8th international conference on tribology, 30thoct.-1stnov.2014, sinaia, romania
4. TejasUmale, Amarjit Singh, Y. Reddy " Abrasive Wear Behaviour Of Copper-Sic And Copper-Sio2 Composites"International Conference On Ceramics, Bikaner, India International Journal Of Modern Physics: Conference Series Vol. 22 (2013) 416–423
5. J. W. Kaczmar, K. Granat, E. Grodzka, A. Kurzawa "Tribological properties of Cu based composite materials strengthened with Al2O3 particles" ISSN (1897-3310) Volume 12 Special Issue 2/2012 pp33 – 36
6. SyedNasimulAlam and Harshpreet Singh "Development of copper-based metal matrix composites: An analysis by SEM, EDS and XRD"Compositional Analysis Supplement May 2014–MicroscopyandAnalysis
7. Tejas K. Vyas, Prof. AkashPandey& Prof. Haresh Patel "A Review on Investigation of Copper Matrix Composite by using Stir casting Method" "Volume - 5 | Issue - 1 | Jan Special Issue - 2015 | ISSN - 2249-555X
8. Jeon, Jin-woo, "Synthesis, Microstructure, and Mechanical Behavior of Fe-Cu Composites."Master's Thesis, University of Tennessee, 12-2005.http://trace.tennessee.edu/utk_gradthes/2092.
9. S.J. Dong, Y. Zhou, Y.W. Shi, And B.H. Chang "Formation of a TiB2-Reinforced Copper-Based Composite by Mechanical Alloying and Hot Pressing" VOLUME 33A, APRIL 2002—1275
10. Jean-François Silvain1, Amelie Veillere1, Yongfeng Lu "Copper-Carbon and Aluminum-Carbon Composites Fabricated by Powder Metallurgy Processes"Eurotherm Seminar 102: Thermal Management of Electronic Systems IOP Publishing Journal of Physics: Conference Series 525 (2014) 012015 doi:10.1088/1742-6596/525/1/012015.
11. Yongzhong Zhan and Guoding Zhang "Friction and wear behavior of copper matrix composites reinforced with SiC and graphite particles" Tribology Letters, Vol. 17, No. 1, July 2004, PP-91-98