International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 5, Issue 05, May-2019

Metallurgical portrayal of AA6061 with Nano Sic Combined by FSP

[1]S.N Sundar, [2] R.Poongothai, [3] V. Sivaraman, [3] S.Suresh Kumar, [4] C.Inigo

[1]*Dept of Mechanical Engineering (MTMR), AMK Technological Polytechnic College, Chennai, Tamilnadu.*
[2]*Dept of Mechanical Engineering (Sandwich course), Central Polytechnic College, Taramani, Chennai, Tamilnadu.*
[3]*Department of Mechanical Engineering, Panimalar Polytechnic College, Chennai, Tamilnadu.*
[2]*Dept of Mechatronics Engineering, Government Polytechnic College, Purasawalkam, Chennai, Tamilnadu.*

Abstract— ***In this research work production of nano Sic armored AMC via FSP method is studied in this paper. The considered substances of Sic nano powder were packed down into a channel of 100 mm × 50 mm x0.5mm plate for the required dimensions. A sole pass of friction stir processing was conceded out with rotational speed of 600 rpm, dispensation speed of 60 mm/min and tool thrust force of 6 KN. An oil hardened tool made of D2 steel having squared contour is worn. Metallurgy and Vickers hardness of the made-up AMC were analyzed. Scanning Electron Microscope revealed a mere even circulation of nano Sic particle which were measly able-bodied to the matrix alloy. The hardness of synthesized surface composite is augmented by 39% elevated than that of the base alloy.***

Keywords— Metallurgy, Nano Silicon carbide, Surface composite, square tool.

I. INTRODUCTION

Composites armored with ceramics show signs of elevated potency, and enhanced opposition to mechanical failures which suits this for numerous structural applications. Generally, exterior property of the products order the life period. The equilibrium of both external and internal property is not probable in standardized supplies. Making of composites for its improved functionality varies by many different methods (i.e.) liquid state and solid state. For doing liquid processing stir casting is majorly used in enhancement of materials functionality which is quite costlier as it is to be made on entire parts in production. [1] This study shows the production of hybrid composite with graphite and alumina and their physical and tribological properties are studied. Results showed increased properties with inclusions of ceramics. [2] This concept shows the liquid metallurgy route of manufacturing composite with aluminum nitride with varying percentages on AA 7075 and its properties like tensile, hardness are studied. [3] In this literature AA 6082 reinforced with nano alumina powder and improved properties are obtained at 3% volume fraction. [4] In this work, fly ash is used with AA7075 for improving the properties through stir casting process and it is characterized.

[5] This paper showed the production of in-situ composites of AA6063 with ZrB2 AMC and its physical properties are defined. Although many types of reinforcements with different methods of synthesizing composites may be used with different combinations on aluminum but still this type of processing is costlier and time consuming. Hence it is enviable by compositing surfaces of parts by the required reinforcement particles despite the fact that interior stuff retains the novel opus. Friction stir processing a tale, green and energy efficient meting out practice to formulate surface composites based on the principle of friction stir welding. [6-8]These works shows the harmless welding of similar and dissimilar metals of same and different materials like aluminum, brass and steel by the use of non consumable, green energy method successfully by varying the parameters for finding optimality.

[9] FSP is worn for producing hybrid composite with the combination of silicon and boron carbide in 2024 aluminum alloy for its characterization both by metallurgically and mechanically. [10] This paper deals with the usage of unlike tool profiles for synthesizing surface composites and the effective tool shape is identified. [11] This work deals with the fabrication of in-situ composites through stir casting which is further friction stir processed for obtaining the improved properties by dissemination of particles produced during the reactions. Hence in the current effort, an endeavor is made to make AA 6061 with nano Sic surface composite and to cram the metallography and hardness distribution of the produced layers.

II. EXPERIMENTAL PROCEDURE

AA 6061 amid 6mm solid plate is used for libeling friction stir processing. Nano silicon carbide powders bought from the Carborundum universal limited with a typical extent of 100 nm is used for the purpose of processing. The optical emission spectroscopy is completed on the purchased aluminum plate to discover its nominal compositions.

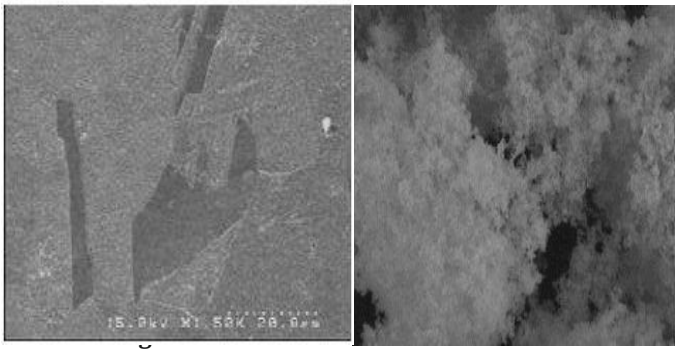

Figure 2 shows Square profile of D2 tool.

The metallurgy of AA6061 and Nano Sic is shown in the SEM image as in figure 1. A channel of 0.5 mm breadth, 2.5 mm deepness and 50 mm span were prepared on the platter and crammed in the midst of nano Sic powder. A contrivance tool made of D_2 steel, oil hardened having squared outline was used for doing the solid state processing. The square outlined tool had shoulder, pin diameter and span of 25 mm, 6mm and 3.5 mm respectively. The FSP was conceded at a tool gyratory rate of 600 rpm and a pass through speed of 60 mm/min. A descending thrust power of 6KN was functional on the tool at the stage of friction stir processing. Also the FSP was conceded out on customized heavy duty milling machine. A D_2 steel tool with no profile was primarily engaged to swathe the top of the channel after substantial packing with Nano Sic powder to avert them from thinning out during friction stir processing.

Samples are primed in the FSP route to cart out depiction. The samples were cultured as per metallographic course of action and engraved with Keller's reagent. The microstructures were experiential by Scanning Electron Microscopy. The Vickers hardness was calculated with a micro hardness tester (MITUTOYO-MVK-H1) at 500 gram consignment, functional for 12 seconds on the set sample.

III. RESULTS AND DISCUSSION

Metallurgical characterization

The friction of tool produced the heat which plasticized the matrix and dynamic rousing scattered the crammed nano Sic into the alloy. Furthermore, traverse of D_2 steel tool moves the plasticized composite from advancing to retreading side synthesizing surface layer. Figure 3 shows the upper exterior facade of the made-up Surface Metal Matrix Composites. The channel is efficiently bunged ensuing to Friction Stir Processing. Defects resembling voids as well as cracks, pin and worm hole are not pragmatic on the exterior processed area. Figure 3 also displays very flat processed surface with no depression due to stirring. The square pin extent is 0.3 mm elevated that of the channel deep which assures to be sufficient to fabricate by complete incursion.

Figure 3 Crown appearance of produced composite layer.

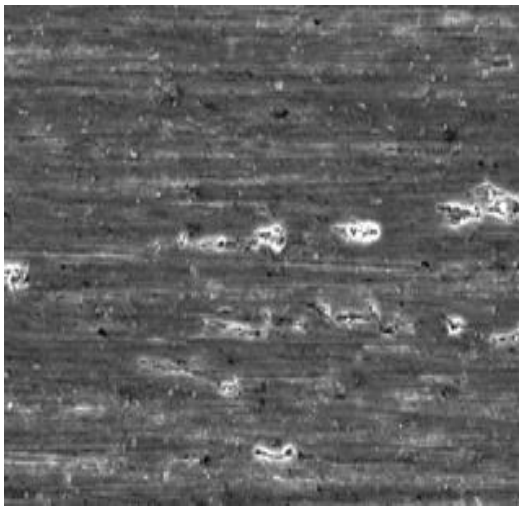

Figure 4 Shows the SEM of FSP region.

Nano particles of silicon carbide are somewhat able-bodied in the processed region. Square profiled tool stirring caused more plastic sprain which rearranged the nano silicon carbide powder on the interior of the matrix. From figure 4 it is obviously seen that dimension of nano silicon carbide powder is not identical all through the friction processed sector. Moreover, disparity in sizing of nano powder is minimum which shows modest comminuting for the period of processing.

Mechanical characterization

Figure 5 displays the Vickers micro hardness values in the fabricated composite layer. Major strengthening mechanisms involved during FSP are Orowan strengthening and Grain- substructure strengthening. Increased hardness with good bonding in the layer fabricated is owing to the fine spreading of nano silicon carbide powder which is purely by Orowan strengthening mechanism.

Moreover, since a channel was ended at the middle of the AA6061 plate to slot in the nano powder, the matrix flowed into the channel and gave a defect-free stirred zone. Hence, FSW and FSP both took place at the center with little deformation. Nano powders superiored the hardness of AA 6061. The mean hardness of friction stir processed region is 39% elevated that of the base material.

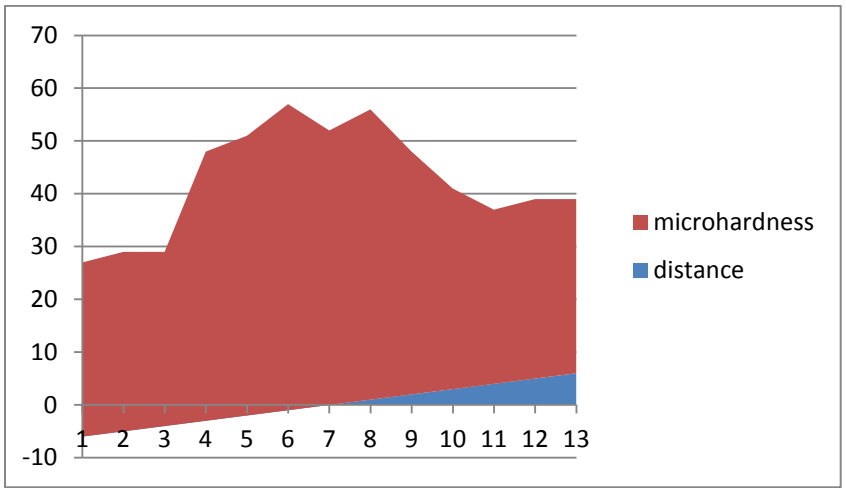

Figure 5 shows the Micro hardness of FSPed zone.

IV. CONCLUSION

Friction stir processing of surface metal matrix composite of Aluminum alloy 6061 with 100nm silicon carbide particles were made-up successfully. The chosen parameters formed superior composites with no defects. The layers of matrix and powder were well-bonded due to the heat and mechanical stirring created by tool at the stage of processing. Nano particles were disseminated somewhat consistently in the fused area. Furthermore, micro hardness assessment displayed amplified hardness by 39% which is privileged than of the base AA6061.

REFERENCES

1) V.Mohanavel, K.Rajan, M.Ravichandran, S.Suresh Kumar, M.Balamurugan, C.Jayasekar "Physical and Tribological behavior of dual particles reinforced metal matrix composites" Lecture Notes in Mechanical Engineering Vol 2, Jan 2019, 339-347.
2) V.Mohanavel, S.Suresh Kumar, T.Sathish, T.Adithiyaa, K.Mariyappan " Microstructure and mechanical properties of hard ceramic particulate reinforced AA 7075 alloy composites via liquid metallurgy route" Material Today proceedings, 5(2018), 26860-26865.
3) V.Mohanavel, S.Suresh Kumar, T.Adithiyaa, K.Mariyappan, P.Ganeshan "mechanical behavior of Al-matrix nano composites produced by stir casting techniques" Material Today proceedings, 5(2018), 26873-26877.
4) V.Mohanavel, A.Chockalingam S.Suresh Kumar, R. Praveenkumar "characterization of mechanical properties of aluminium fly ash composites fabricated through stir casting process" International Journal of mechanical and Production Engineering Research and Development, Special issue, June 2018, 377-382.
5) V.Mohanavel, S.Suresh Kumar, T.Sathish, K.T. Anand "Effect of ZrB2 content on mechanical and microstructural characterization of AA6063 aluminum matrix composites" Material Today proceedings, 5(2018), 13601-13605.
6) Ramesh R, Suresh Kumar S, Srinivasan R.V. "Effect of process parameters on mechanical characterization of dissimilar friction stir welded aluminium alloys" Applied Mechanics and Materials, 799-767, 2015, 701-704.
7) Suresh Kumar S, Sivakumar B.G, Jeeva N.T, Amudhan A.N. "Effect of mechanical properties on similar friction stir welded AA 6082" International Journal of Applied Engineering Research, 10 (2), 2015,1725- 1729.
8) K.Mariyappan, K.Praveen, S.Suresh Kumar, K. Kadambanathan, S.Rajamanickam, R.Vignesh "Characterization of brass/steel plates joined by friction stir welding" International journal of Engineering and Technology, 7(3.34), 2018, 366-368.
9) S.M.Sivagami, S.Suresh kumar, R. Prithivirajan, P.Narayanasamy, P.Thirunavukkarasu "Characterization of aluminium alloy 2024-T351/ different hybrid ratio of sic and B4c fabricated by friction stir processing" International Journal of Applied Engineering Research, 10 (57), 2015, 444- 448.
10) R.Mohan, N Alagirisamy, S.Suresh Kumar, M.Prahadeswaran "Characterization of friction stir processed AA6063/nano sic surface composites with different tool profiles" International Journal of Applied Engineering Research, 10 (68), 2015, 594- 597.
11) S.Murali, .A.Chockalingam S.Suresh Kumar, Manu Remanan " Production Characterization and friction stir processing of AA6063/Al3TI in-situ composites" International Journal of Mechanical and Production Engineering Research and Development, Special Issue, June 2018, 399-406.