Metallurgical and Microstructural Analysis on Diffusion Bonding of Mg/Al Alloys using Aluminium Coating Interlayer

R. J. Golden Renjith Nimal, M. Chenthil, P. Gnaneswar, Somu veerendranath, B. Ganesah Reddy

Abstract- ***This work is conducted to obtain better understanding and characterization of the diffusion bonding of similar and dissimilar metals. It also aimed to obtain optimum parameters for diffusion bonding of aluminium coating over magnesium alloy with aluminium alloy. This work aims at developing a simple method to obtain diffusion bonding joints at relatively not low cost. On one hand, the research is intended to establish a method. It is not much easy to perform fusion welding of dissimilar metals of entirely two different metal species and getting a sound joint. Therefore an alternate method is essential, for this solid state welding is the right method, among several such processes diffusion bonding is one of the solid state welding process suitable for joining aluminium coating over magnesium alloy with aluminium alloy. On the other hand, the method is to serve as the basis for further research for production of application oriented components and parts. These two metals are jointed inside the die after finishing surface treatment. Then the die is kept inside the diffusion bonding machine by varying the time, temperature, pressure by means of load. Hot press diffusion bonding equipments is fabricated and verified with experiments so that it is capable of rendering accurate diffusion bonding joints with facilities to measure parameters and to investigate the super plastic diffusion bonding joints with interlayer. This method is devised to study the microstructural and metallurgical characteristics of the joint.***

Keywords: Diffusion Bonding, AA7075, AZ 80, interlayer, SEM, XRD

I. Introduction

AZ80 and AA 7075 find greater applicability in all fields of industrial sectors owing to their unique features, namely low density, high specific strength and good ductility.

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The weldability of these alloys is a critical task and raises challenges due to the formation of inclusions in the refractory oxide film of Mg & Al in the heat-affected zone. Moreover, Mg exhibits thermal brittleness making difficult the welding of Mg-Al dissimilar materials by conventional fusion welding techniques. Mechanical and metallographic examinations reveal the formation of distortions and cracks in the heat affected zone of Mg. The literature pertaining to the diffusion bonding of AZ80 Mg alloy and AA7075 Aluminum alloy is either scanty or insufficient. Hence, in this study, an attempt is made to join AZ80 Mg alloy & AA7075 Al alloy dissimilar materials using diffusion bonding and to evaluate their strength and bond integrity.

II. Experimental work

A diffusion bonding or diffusion welding compound could be a solid-state compound technique used to connect similar or dissimilar metals. The sample size is 45 mm × 45 mm. The aluminium AA7075 alloy and magnesium AZ80 alloys is kept in a die after surface preparation.

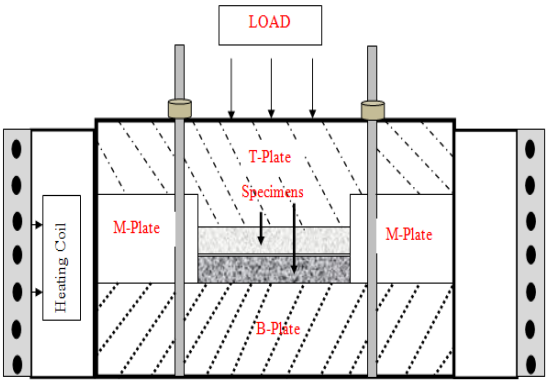

Fig. 1 Diffusion bonding die set up

The surface preparation which includes polishing and rinse with acetone to avoid oxidation. When atoms of two solid gold plating surface alternate with time, it works supported the principle of solid diffusion. This can be usually achieved at the corresponding elevated temperature, i.e. regarding 50 to 70% of absolutely the temperature of the fabric. The diffusion compound is in principle provided by adding warm temperature to the fabric to be welded together with really extreme temperature. welding "thin sandwich" alternating layers of skinny metal foil and metal wires or threads is most frequently welded to the present technology. Currently,

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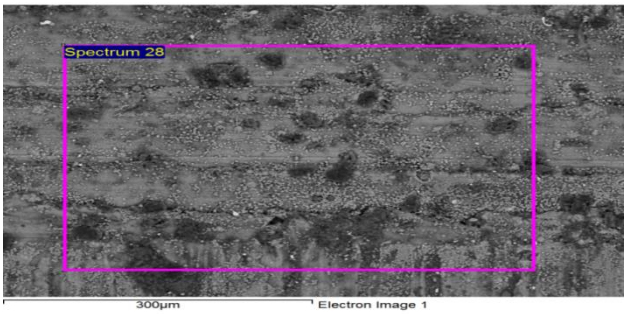
diffusion bonding methodology is wide wont to connect high strength and refractory metals inside the region and inside the nuclear trade. The mechanical



Percentage of Elongation	14	11
Shear strength (MPa)	195	337

III. Results and Discussion

The diffusion bonded samples are shown in photograph.

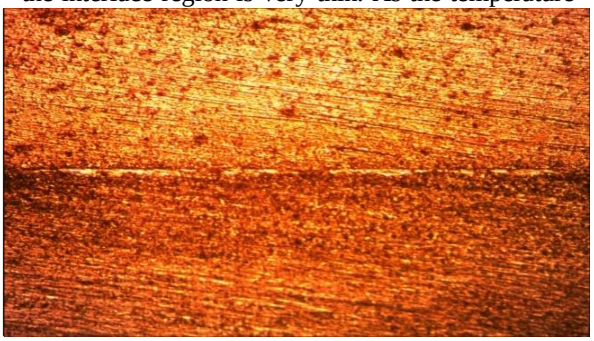
Fig. 2 Diffusion Bonded Samples

A. OPTICAL MICROSCOPIC TEST RESULTS

The metallurgical magnifying lens frequently alluded to as a light magnifying lens, is a sort of magnifying lens which utilizes unmistakable light and an arrangement of focal points to amplify pictures of little examples. The metallurgical magnifying instrument photo has appeared as follows.

Fig. 3 Optical Microscopic

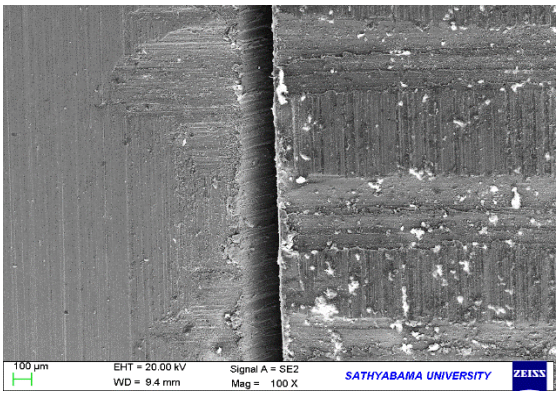
The diffusion of both the layers could well be correlated to the lap shear strength (LSS) and ram tensile strength (RTS). At lower temperature of 375˚ C, the interface region is very thin. As the temperature



is increased the diffusion layer increases which could be seen from our earlier discussion of LSS and RTS with an increased strength in both the values. The LSS value increases from 15 MPa to 26 MPa and RTS value increases from 17 MPa to 19 MPa. As the temperature is further increased to 425˚ C, the width of the middle diffusion layer increases. While considering the strength of the same sample under investigation we could easily observe a marginal decrease in the strength. This may be attributed to the grain growth due to the increased temperature.

B. SEM TEST RESULTS

A field emission scanning electron microscope (FESEM) is a kind of electron magnifying lens that produces high amplification pictures of an example by checking it with engaged light emission.



Scanning Electron Microscope (SEM) is utilized to explore the surface morphology of the dissemination fortified example. In the present examination, the SEM picture of aluminum covered Mg/Al compound composite was done. The improved very much ensured tests that were warmed to 400˚C was used in the present examination.

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The holding weight was kept up at 10 MPa with a holding time of 15 min. The all-around ensured tests were taken required sizes and subsequently, the SEM picture is found out to break down the dissemination system.

IV. CONCLUSION

Dispersion holding of AZ80 metal amalgam and AA7075 Al composite, show most shear quality for the instance verified at 400° C, 10 MPa and 15 min. The tensile shear quality of the verified examples is decided to stretch out with increasing temperature until the foremost price is returned to on the so much aspect that it diminishes. The expansiveness of the between metallic is smaller at a lower dispersion holding temperature and their widths increment with the ascent within the association temperature on account of an increment within the between dissemination of concoction species. The thickness of IMC's is relative to the temperature and holding time. Once the holding time is longer than the inert add, the saturated strong arrangements appear to be shaky. Intermetallic locus nucleates and developed, whereas AlMg section was absent.

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