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Effect of Temperature and Microstructural Evolution of Magnesium and Aluminium Alloy Using Vacuum Diffusion Bonding

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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. This method is devised to study the physical phenomena that have significant influence on diffusion bonding such as time, temperature, pressure on joints and metallurgical characteristics. Tensile and shear tests are to be conducted. 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 aluminum coating over magnesium alloy with aluminum alloy. 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.*

Keywords--- *Effect of Temperature, Microstructural Evolution, Diffusion Bonding.*

I. INTRODUCTION

AZ80 and AA 7075 finds larger relevance altogether horizons of commercial sectors attributable to their distinctive options viz., tenuity, high specific strength and smart plasticity. they're thought of as subtle materials utilized usually with the target of minimizing the structural weight, increasing fuel potency and to scale back to induced stress at higher accelerations. Weld ability of those alloys could be a vital task and poses challenges as a result of the formation of oxides and intermetallics within the bond region. The refractory chemical compound film of Mg & Al forms inclusions within the heat-affected zone. Moreover, Mg exhibits thermal crispness creating the attachment of Mg/Al dissimilar material troublesome by the traditional fusion attachment techniques. Mechanical and metallographic examinations reveal the formation of distortions and crack within the heat affected zone of Mg. However, diffusion bonding is found to be appropriate for connexion these alloys while not abundant issue. The vacuum diffusion bonding with the event of advanced pc and vacuum techniques is employed in connexion brittle and dissimilar materials. After, the cracks, distortion and segregation created throughout fusion attachment is also eliminated in vacuum diffusion bonding.

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Table 1: Mechanical properties of the base metal

Mechanical Properties	Mg alloy	Al alloy
Density (Kg/m^3)	1.78x10^3	2.9x10^3
Ultimate Tensile strength (MPa)	351	580
Elongation (%)	17	11
Shear strength (MPa)	199	342

II. Experimental Analysis

Rectangular formed specimens (45 millimeter x 45 millimeter) were machined from rolled plates of ten mm thickness metallic element (AZ80) and metal (AA7075) alloys. The polished and with chemicals treated specimens were stacked in a very die created of 316L stainless-steel and also the entire diffusion bonding setup, shown in Fig. 2, was inserted into a chamber (vacuum pressure of a hundred and forty pressure unit is maintained). The specimens area unit het up to the bonding temperature victimisation induction chamber with a heating rate of 250C/min; parallel the specified pressure was applied. once the completion of bonding, the samples area unit cooled to temperature before removal from the chamber. twenty seven trials of dissimilar joints area unit fictitious victimisation completely different combos of bonding temperature, bonding pressure and holding time.

Effect of Temperature

Sl. No	Temperature	Pressure	Time	Remarks
1.	350	10	15	Not Bonded
2.	375	10	15	Bonded
3.	400	10	15	Bonded
4.	425	10	15	Bonded
5.	450	10	15	Deformed

(a) Not Bonded Specimen (b) Bonded Specimen (c) Deformed Specimen

III. Results And Discussion

The interface of AZ80 Mg alloy/AA7075 Al alloy diffusion warranted joint made the plain diffusion between the Az80 Mg alloy substrate and therefore the AA7075 Al alloy substrate within the condition of the diffusion bonding. After the bonding method, the macro deformation isn't ascertained at the warranted samples. All warranted samples were made with sound bonding with none small pores, micro-crack and compound. The new bright section is made

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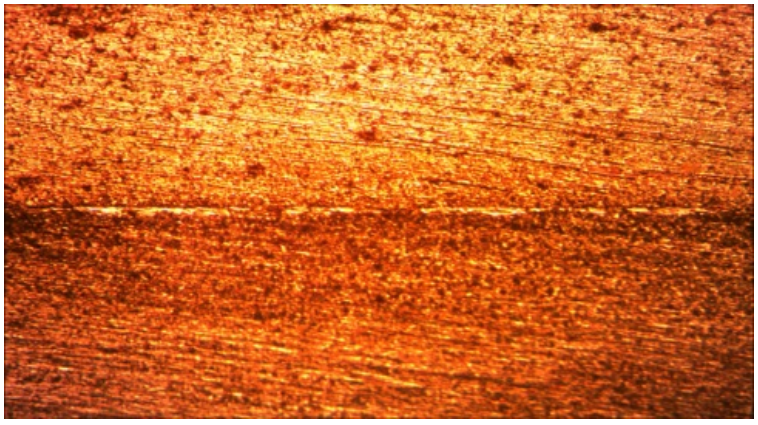
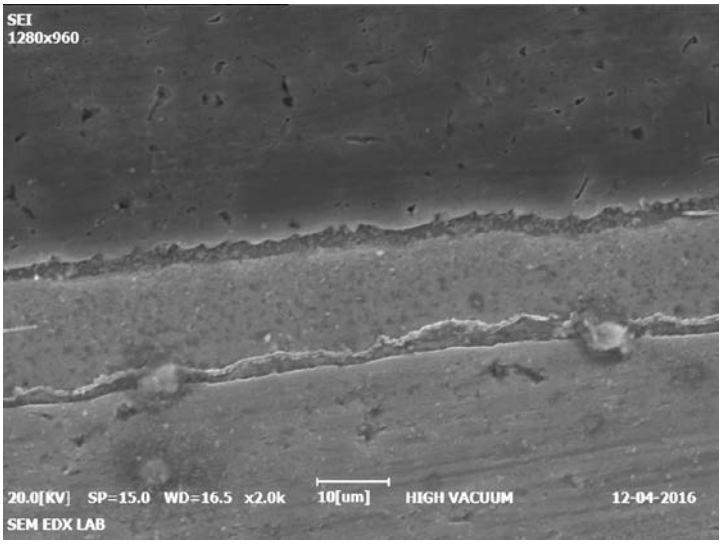
at the interface. in keeping with Mg-Al section diagram, the new section of Mg-Al intemetallics is made once the heating temperature is 375^{o}C to 425^{o}C.

There is an apparent boundary between the AA7075 Al alloy substrate and therefore the diffusion zone. But the boundary isn't obvious between the Az80 Mg alloy substrate and therefore the diffusion zone. The testing specimens are characterized by means of optical microscope and also scanning electron microscope (SEM).

Optical microscope image for test specimen



SEM image for test specimen



IV. CONCLUSION

The optimization of bonding parameters for diffusion bonding magnesium AZ80 alloy and aluminum AA7075 alloy are to be diffused in a diffusion bonding machine and the die is kept inside the diffusion bonding machine by varying the time, temperature, pressure by means of load. Before making diffusion bonding equipment, experiments are conducted with high expensive and simple fixture which is kept inside an induction furnace in clamping position

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to get diffusion bonded joints. Hot press diffusion bonding equipment 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. This method is devised to study the physical phenomena that have significant influence on diffusion bonding such as time, temperature, pressure on joints and metallurgical characteristics. Tensile and shear tests are to be conducted and optical Microscope and micro hardness test are also conducted. For the diffusion bonding of Az80 Magnesium alloy and AA7075 Aluminum alloy, the maximum shear strength was obtained for the specimen bonded at 400^{o}C ,10 MPa and 15 minutes. The tensile shear strength of the bonded specimens was found to be increased with increasing temperature until a maximum value is reached beyond which it decreased.

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