Advances in Automobile Engineering
ISSN: 2167-7670

Bao and Yang, Adv Automob Eng 2018, 7:1
DOI: 10.4172/2167-7670.1000182

Commentary | Open Access

Microstructure and Properties of 5083 Al/1060 Al/AZ31 Composite Plate Fabricated by Explosive Welding

Jiawei Bao and Suyuan Yang*

School of Materials Science & Engineering, Beijing Institute of Technology, 15 South Zhongguancun Street, Haidian District, Beijing 100081, P.R. China

Commentary

Magnesium alloys have many helpful properties, such as a high specific strength, a high stiffness, and excellent dimensional stability. However, because of their low ductility at room temperature and poor corrosion resistance, Mg alloys have not been widely used in industrial settings compared with other metals. Aluminum alloys have the characteristics of good ductility and corrosion resistance, which are exactly the weaknesses of magnesium alloy. To combine these two alloys would be one way to expand the applications of magnesium alloy. Former researchers have fabricated various types of magnesium alloy/aluminum alloy composite plates and carried out detailed studies [1-6]. Unfortunately, reports on the explosive welding of 5083 Al/AZ31 composites are difficult to find. Based on previous studies by Wu [6], the maximum bonding rate of 5083 Al/Z31 composite plates fabricated by explosive welding is merely 47.7%. In order to fabricate a composite plate consisting of 5083 Al and AZ31 plates with a high bond rate while maintaining an acceptable strength, an equivalent density of magnesium alloy, and increased corrosion resistance. 1060 Al was selected as an additional interlayer between 5083 Al and AZ31 plates to fabricate a defect-free composite plate.

5083 Al/1060 Al/AZ31 composite plate was fabricated under appropriate stand-off distance and explosive. The bonding rate of the 5083 Al/1060 Al and 1060 Al/AZ31 was determined by an ultrasonic test, with the results showing that both bonding rates exceeded 85%. The microstructure was investigated by scanning electron microscopy (SEM). Wavy morphology was found on all bonding interfaces of the 5083 Al/1060 Al/AZ31 composite plate. Through analyzing the wavelength and amplitude of the morphology, it can be found that, with an increasing distance from the initiation point, the wavelength and amplitude also increase. From the same position, the wavelength of the 5083 Al/1060 Al interface was less than that of the 1060 Al/AZ31 interface. The microstructure evolution law in AZ31 was also found. Magnesium grains near the interface were divided into several finer grains of a strong impact, and many shear bands originated from the interface and disappeared in the AZ31 alloy. Between those shear bands, twin structures occurred along the horizontal direction. And due to the large deformation caused by the collision, twins were crushed into many small grains, and secondary twins formed between larger twins. It demonstrated that materials near the interface suffer huge deformation and adiabatic shear bands, while the twins coordinate the violent deformation together. When the distance from the interface increased, the deformation was accommodated by twinning. Far away from the interface, as the deformation decreased significantly, deformation structures completely disappeared and the microstructure returned totally to the original microstructure.

By using EDS element analyses across the interface of the 1060 Al/AZ31, there was a thin diffusion layer in the bonding interface, with a thickness of approximately 5μm. The inter-metallic compounds of Mg_2Al_3 and $Mg_{17}Al_{12}$ were observed to form at the bonding interface by using TEM.

The properties of the composite plate were determined by shear tests. The shear bond strength of the 5083 Al/1060 Al interface was 60 MPa, and the shear bond strength of the 1060 Al/AZ31 interface was achieved at 84 MPa. Though the shear bond strength of the 1060 Al/AZ31 interface was higher than the reported values, it showed apparent brittleness, which may be due to inter-metallic compounds at the interface.

References

1. Findik F (2011) Recent developments in explosive welding. Mater Des 32: 1081-1093.
2. Nan Z, Wenxian W, Xiaoqing C (2015) The effect of annealing on the interface microstructure and mechanical characteristics of AZ31B/AA6061 composite plates fabricated by explosive welding. Mater Des 65: 1100-1109.
3. Yan YB, Zhang ZW, Shen W, Wang JH, Zhang LK, et al. (2010) Microstructure and properties of magnesium AZ31B-aluminum 7075 explosively welded composite plate. Mater Sci Eng A 527: 2241-2245.
4. Wu Q, Suyuan Y (2016) Microstructure and properties of bonding interface in explosive welded AZ31/1060 composite plate. Chin J Rare Met 40: 996-1001.
5. Pengwan C, Jianrui F, Qiang Z, Erfeng A, Jingbo L, et al. (2016) Investigation on the Explosive Welding of 1100 Aluminum Alloy and AZ31 Magnesium Alloy. JMEPEG 25: 2635-2641.
6. Qiong W (2016) Study on welding technology of magnesium alloy/aluminum alloy composite plate. Master's research, Beijing Institute of Technology. Beijing.

***Corresponding author:** Suyuan Yang, School of Materials Science & Engineering, Beijing Institute of Technology, 15 South Zhongguancun Street, Haidian District, Beijing 100081, P.R. China, Tel: 86-10-68911152; E-mail: yangsuyuan@bit.edu.cn

Received March 12, 2018; **Accepted** March 19, 2018; **Published** March 23, 2018

Citation: Bao J, Yang S (2018) Microstructure and Properties of 5083 Al/1060 Al/AZ31 Composite Plate Fabricated by Explosive Welding. Adv Automob Eng 7: 182. doi: 10.4172/2167-7670.1000182