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Study on Possibility of Friction Stir Weldi
Thickness Materials (Aluminu

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Abstract

Friction stir welding (FSW) is a relatively new meth
consumable rotating tool for creating frictional heat and
This project concentrates possibility of friction stir
dissimilar and non uni-thichness metals (copper to al
speed and travel speed of the tool was in the range of 6
after acquired the optimum welding parameters the mic
was studied. The flow of material in the stirred zone (
because of stirred dissimilar materials. Microstructure i
weld zone due to mechanical working. Grains are elonga
results show that the hardness in the SZ is rather than ba
is formation of very fine grains in the weld zone due to p

Keywords: Friction Stir Welding, Butt Joint, Dissimilar

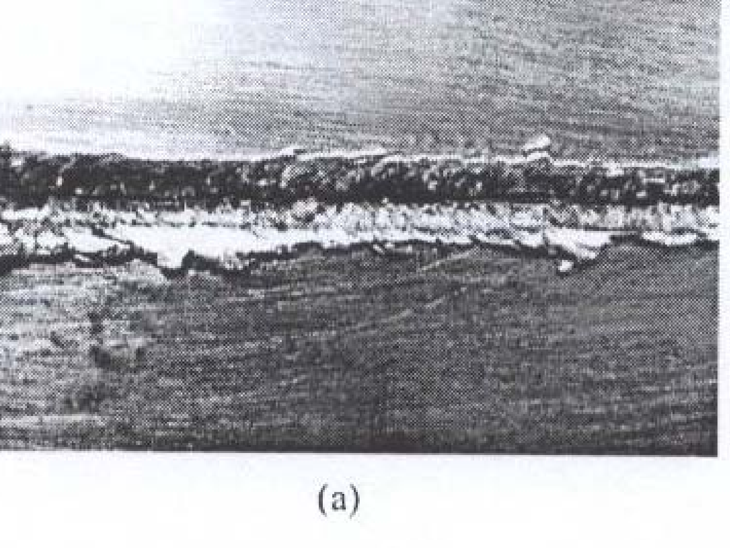
1 INTRODUCTION

Friction stir welding (FSW) is a recent welding technique, introduced by The Welding Institute (TWI), Cambridge, UK. This technique utilizes a non-consumable rotating welding tool to generate frictional heat and deformation at the welding location, thereby affecting the formation of a joint, while the material is in the solid state. The principal advantages of FSW, being a solid-state process, are low distortion, absence of melt-related defects and high joint strength [1, 2].

A non-consumable rotating tool with a pin and shoulder is entered into the work pieces edge and traversed along the line of joint (Fig. 1). The tool performs two functions: (a) heating of work piece, and (b) movement of material to produce the joint. The heating is producing by friction between the tool and the work piece and plastic deformation of work piece. The heating softens the material around the pin and combination of tool rotation and translation leads to movement of material from the front of the pin to the back of the pin. As a result of this process a joint is produced in 'solid state' [2].

The producing temperature is also thought to be sufficiently high to cause recovery and recrystallization. It is said that FSW contains dynamic recrystallization (DRX) and / or dynamic recovery (DRV) [1-3]. During cooling, some tempering / aging can take place due to back heating and, in addition, static recrystallization (SRX) and recovery (SRV) can also become operative; the term static signifies that no deformation is involved [1-3]. Beneath the shoulder a finite width area formed and Chen et al.

Test pieces were first ground using steel brush and sandpaper to remove the oxide film, and then cleaned by acetone to remove organisms such as oily soil. Plates were fixed in machine by fixture. Using fixture cause the plates don't move when the plates were placed on a flat metal plate. The welding was started. It is important that there is no distance between the plates during the welding. The tool was made from H13 steel. For the better material flow the pin was threaded. Because of high thermal conductivity of copper the plates were preheated about 200°C before welding. Welding parameters were selected according to the materials and plates dimensions. Tilt angle was about 1.5°. The rotating direction was clockwise from aluminum to copper. Therefore aluminum was in the retreating side and copper was in the advancing side. The welding was done at different rotation speed from 630 to 1600 rpm and traverse speed from 25 to 50 mm per minute. After several welding, totally two adequate specimen were achieved. The shoulder diameter was 8mm and the pin was threaded frustum. Two specimens were welding by traverse speed of 25 mm per minute and 800 and 630 rpm. For microstructure analysis, the welds were sectioned longitudinally and cross-sectionally. The sectioned samples were prepared using standard metallographic procedures. The samples were etched using a modified Keller's reagent (nominally; 150 ml water, 3ml nitric acid, 6ml hydrochloric acid, and 6ml hydrofluoric) for the aluminum alloy side. The copper side was etched with a solution consisting of 100 ml of water, 4 ml of saturated sodium chloride, 2 g of potassium dichromate, and 5ml of sulfuric acid. Observations of plastic deformation, material flow, and microstructure were performed using a high-



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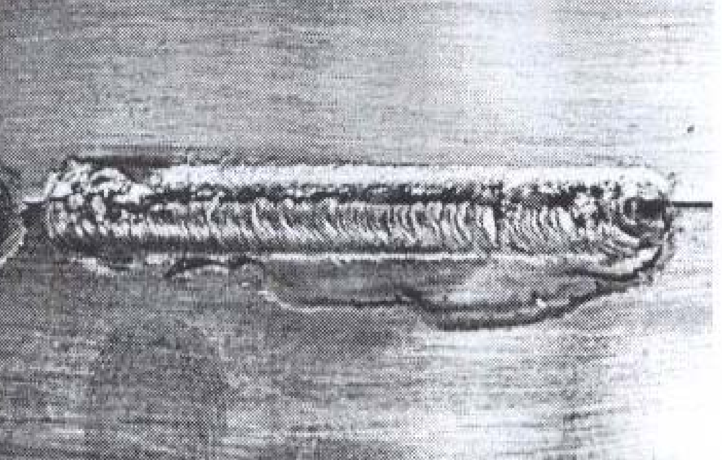

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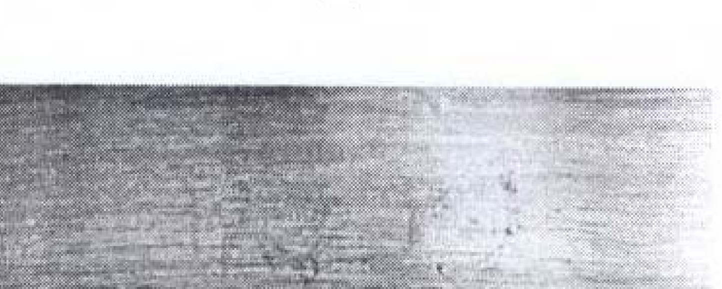

Fig. 2

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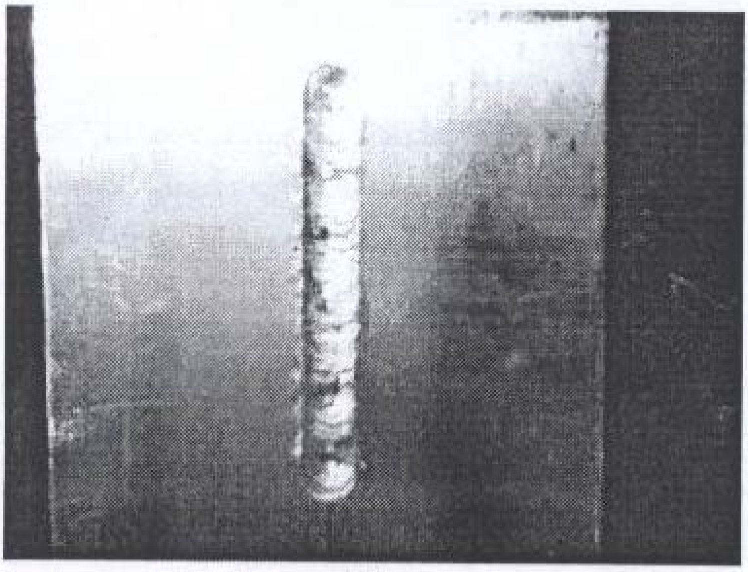
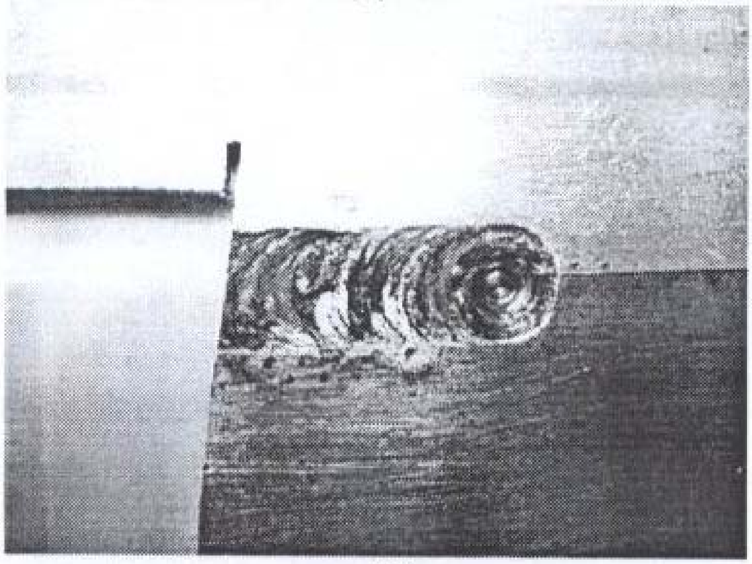
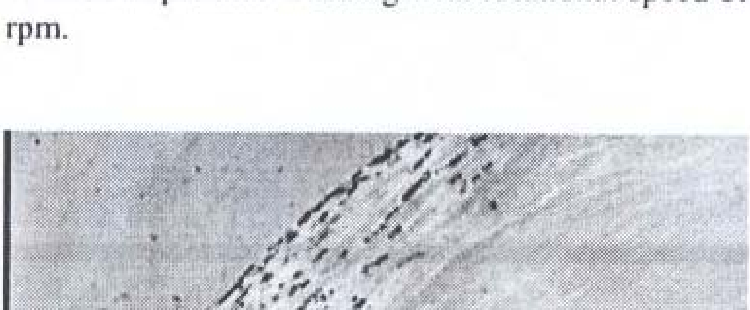


(a)



(b)

Fig. 3 Appearance of the qualified samples. a. The sample that Welding with rotational speed of 800 rpm. b. The sample that Welding with rotational speed of 630 rpm.



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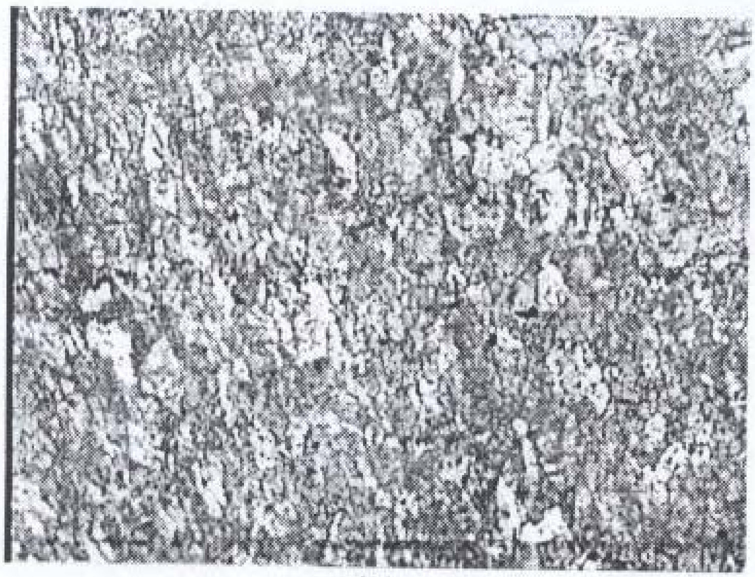
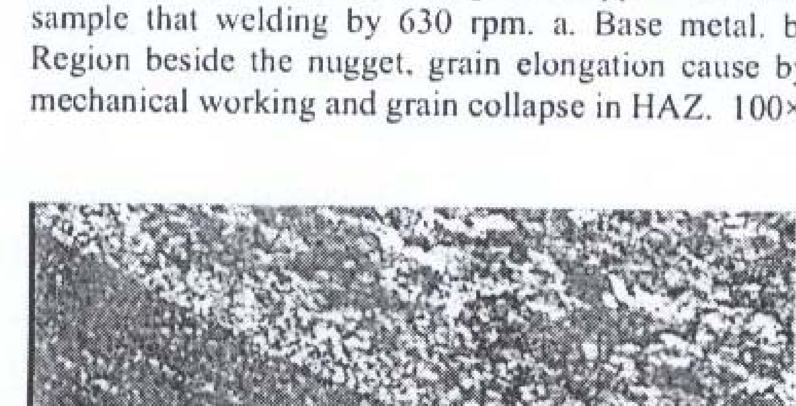


(a)

(b)

Fig. 6 Optical Microscope images of copper side from sample that welding by 630 rpm. a. Base metal. b. Region beside the nugget, grain elongation cause by mechanical working and grain collapse in HAZ. 100×



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suggested to use a kind of interlayer to produce sound welds.

(2) The mechanically mixed region in a dissimilar aluminum alloy/copper weld showed an intercalated microstructure or vortex flow pattern. Distinctly different hardness levels from 150 to 220 HV10 were produced in the weld nugget corresponding to various microstructures and material flow patterns. The hardness tends to increase with an increase in welding speed. It is considered that the variation of hardness is related to the microstructural changes in the SZ induced by welding conditions.

(3) In the weld zone grain growth has seen from top to bottom of the sample due to the mechanical working cause by tool and the grains elongated in direction of pin rotation.

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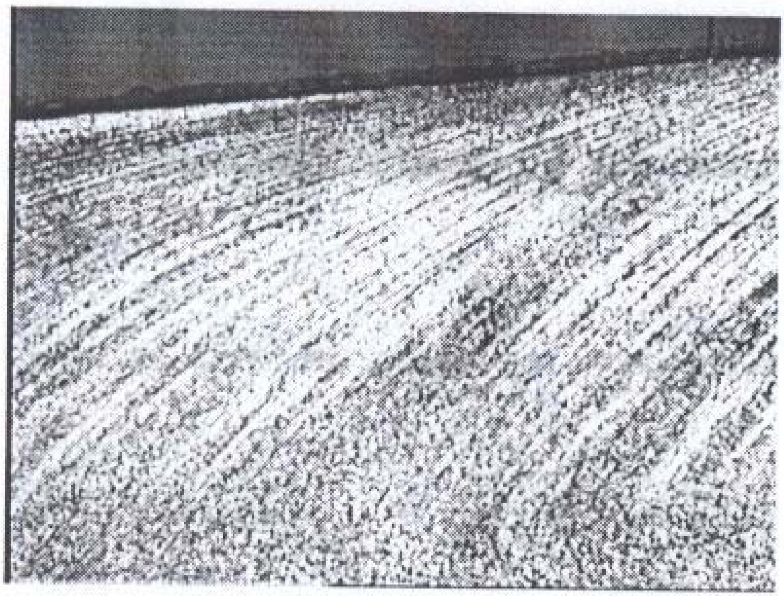

Fig. 8 Onion rings in the advancing side (copper plate) 100×

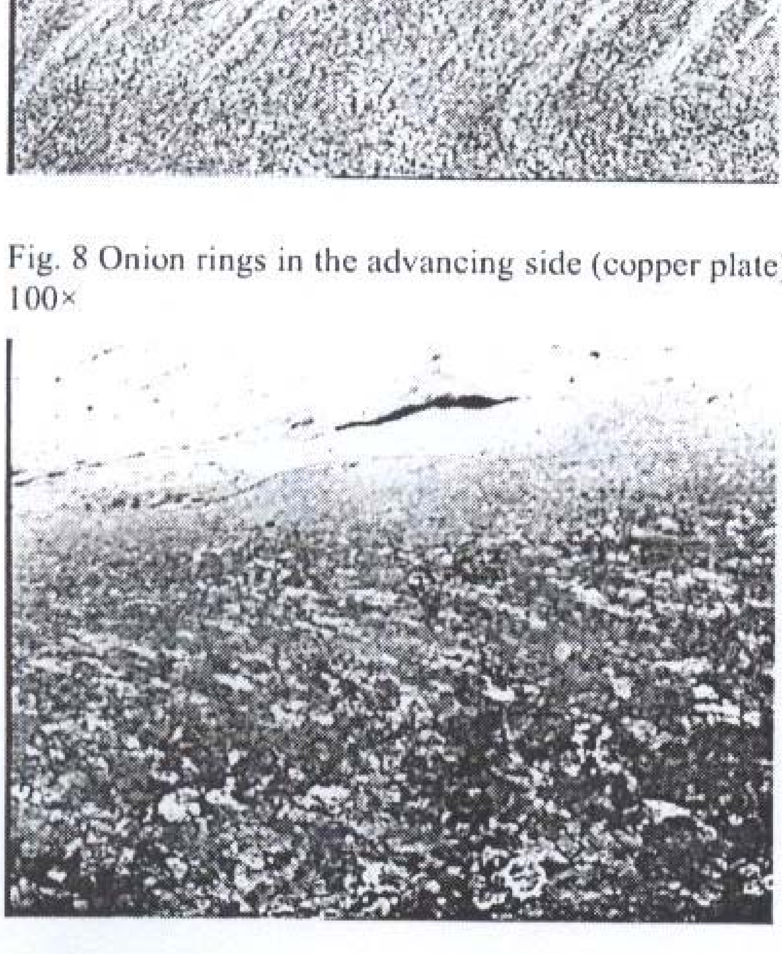

Fig. 9 Grain growth from top to bottom of the sample in longitudinal section. 100×

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