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using solid / liquid state reaction, as shown in the previous works. However, in case of a combination between magnesium and aluminum alloys, difference of melting point between the materials is very small. The key technology for welding of dissimilar metals is to control the shape and composition of molten metal. In the present study, the direct lap joint technique between AZ31B and A5052-O was studied by using Nd:YAG laser. Joints were obtained when laser was applied on AZ31 at the center of lapping width. However, the joints showed very low failure load. Formations of an intermetallic layer at the interface and an under cutting were the main reasons for poor strength. FEM analysis was performed to estimate the temperature distribution at the interface. According to the results of analysis, it was considered that contact-block, twin beam and edge line welding could be effective to improve the strength of dissimilar metals welding, AZ31/A5052. Laser welding tests were carried out based on the results of FEM analysis. The strength of the welding joint obtained by the above method was comparable with the strength of the joint made by solid state welding technique such as friction welding and diffusion bonding.

AWB-03: The Cleaning Effect of the Interlayer Metal on the Joining Surface during Braze Pressure Welding

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Braze Pressure Welding (BPW) with high frequency induction heating is the newly developed pressure welding technique using the interlayer metal for welding the general steel pipes for the pipe arrangement in buildings. BPW enable to make joints by solid-state welding in air with relatively small deformation. In this method, the interlayer metal is expected to play the primary role in making the high performance joints. It removes the contaminations from the joining surface of the base metal and forms the fillet at the gap around the joint. It had been revealed by some experiments and/or numerical analyses in previous research that the BPW joint had higher tensile strength than the brazed joint and the fillet can improve the joint strength. In this study, in order to investigate the cleaning effect of interlayer metal more closely, a low carbon steel plate specimen was brazed mainly by Ni-based brazing filler using tungsten spacer. The microscopy and EPMA analysis on the joints made by various brazing temperatures and durations confirmed that the oxide films on the joining surfaces were removed and discharged from the joining region by the interlayer metal.

AWB-04: Automatic Welding System Using Speed Controllable Autonomous Mobile Robot

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A prototype of autonomous mobile robot with two vision sensors for automatic welding of steel plates was constructed. The robot can move straight, steer and turn around the robot center by controlling the driving speed of the two wheels respectively. At the tip of the movable arm, two CCD cameras are fixed. A local camera observes the welding line near the welding torch and another wide camera observes relatively wide area in front of the welding part. The robot controls the traveling speed in accordance with the shape of the welding line. In the case of straight welding line, the speed of the robot is accelerated and the welding efficiency is improved. However, if the robot finds a corner of welding line, the speed is decelerated in order to realize the precise seam tracking and stable welding. Therefore, the robot can realize precise and high speed seam-tracking by controlling the travel speed. The effectiveness of the control system is confirmed by welding experiments.

AWB-05: Deformed Behavior on High Speed Welding Bead with Very Thin Aluminum Sheet

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Butt welding with aluminum sheets of 0.3 mm in thickness has been performed at welding speed $V=1500 \sim 6000$ mm/min with ordinary inverter controlled TIG welder. Aluminum sheets have been clamped between copper plates to restrain weld heat input of arc what causes deformation for preceding area. Butt weld beads at high welding speed have been examined for mechanical properties. In particular, behavior of tensile deformation at butt weld beads has been clearly photographed through polarizing microscope. The results obtained are as follows: 1) As welding speed becomes high, deformation of butt weld bead has decreased gradually. Deformation of center position at $V=6000$ mm/min has become almost $H_0=0$ mm. 2) Tensile strength of butt weld beads at $V=1500 \sim 6000$ mm/min has been almost $\sigma=83$ MPa, which has been about 66 % of base metal. 3) As welding speed becomes high, fatigue strength has increased gradually, and has been the biggest at $V=6000$ mm/min. 4) Behavior of tensile deformation has been observed by polarizing microscope, consequently, butt weld bead at low welding speed has been deformed by low tensile stresses bigger than at high welding speed within elastic limit.

AWB-06: The Influence of the Solid-State Bonding Process on the Mechanical Integrity of Longitudinal Weld Seams

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For production of complex hollow 6xxx series aluminium extrusions, porthole dies are the predominant tooling set up. In porthole dies, the billet is divided into multiple metal streams, which are rejoined in the weld chamber to form 'longitudinal weld seams'. Fundamental understanding of the solid state bonding process, as well as the ability to detect a well bonded (or a defective) weld seam is critical for of high strength structural hollow extrusions. A study is being conducted to investigate the solid state bonding and weld seam formation processes during extrusion. The method chosen was to use a thermo-mechanical simulator (Gleeble 3500), thereby having the ability to vary process parameters such as strain, strain rate and temperature. The alloy investigated was primary and remelt AA6082. It was determined that the key parameter for bonding is surface stretching (creation of new surface at the interface) and bonding time.

AWB-07: Brazing of Stainless Steel to Various Aluminum Alloys in Air

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The brazing of stainless steel to various aluminum alloys was carried out using the Al-Si filler metal and the fluoride-active flux in air. The brazability was remarkably different by the aluminum alloys and the brazing conditions. It was considered that the differences were originated with the compositions of base metals and the filler metal, the solidus temperature and the partially melting behavior of the aluminum alloys, and the behavior of the surface oxide film layers of both base metals. On the other hand, the obstruction of the brazability was identified as the rapid reaction between the aluminum alloys and the brazing filler metal, which makes the molten brazing filler metal disappear at the joining interface before the wetting occurs to the stainless steel. Taking this phenomena into consideration, it was attempted to make previous wetting of the brazing filler to the stainless steel before brazing to the aluminum alloys. This method provided the successful brazed joint for the most of the combinations of the stainless steel and the aluminum alloys.

AWB-08: Improving Joint Properties of Friction Welded Joint of High Tensile Steel