

# ENHANCEMENT METHOD REAL TIME INSPECTION FOR LASER WELDING PROCESS

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**Abstract:** *In this paper, discussed about once methode of monitoring quality technology of welding was conducted. The laser welding and the industrial robotic systems based laser welding. In this study used laser welding system was 1.6kW fiber laser while the robot system was Industrial robot (payload: 130kg). The robot-based laser welding system equipped with a laser scanner system for remote laser welding. The welding joints of steel plate and steel plate coated with zinc. Controlled laser welding system with laser scanner system is used to increase the processing speed and to improve the efficiency of processes. The welding joints of steel plate and steel plate coated with zinc were the butt and lapped joints. The tested off the laser welding was conducted by observing the shape of the beads on the plate and the cross-section of the welded parts, analyzing the results of mechanical tension test, and monitoring the plasma intensity by using UV and IR sensor.*

**Keywords :** *Inspection, UV, IR, Laser, Welding.*

## 1. INTRODUCTION:

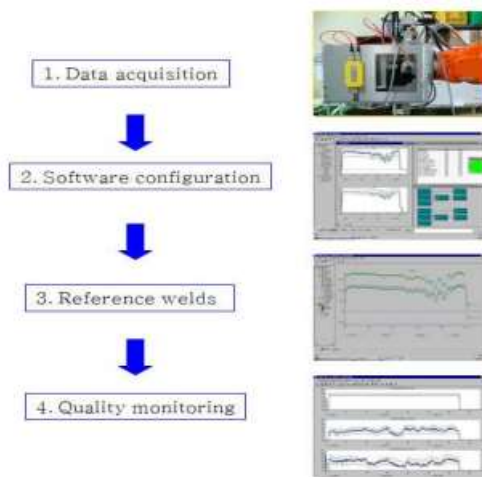
Laser welding is one of the important technologies used in the manufacturing of lighter, safer automotive bodies at a high level of productivity; to that end, the leading automotive manufacturers have replaced spot welding with laser welding in the process of car body assembly. Korean auto manufacturers are developing and applying the laser welding technology using a high output power Nd: YAG laser and a 6-axes robot [1]. The conventional spot resistance welding used in the car body assembly process has been an obstacle to car design and manufacturing due to the limited applicability and lower welding efficiency resulting from the geometry and welding characteristics of spot welding machines [2]. As such, the automotive industry has been trying to develop new welding and joining technologies. This study was conducted to develop a remote car body laser welding technology, a welding quality inspection technique, and a robot control. In particular, due to the characteristics of laser welding - where the laser beams have to be directed perpendicularly to the welding surface - it is very difficult to instruct the robot to direct the laser beam perpendicularly next to a curved surface [3]. Indeed, many studies have been performed to improve the speed of the robot laser welding process and the quality of welding parts. In this study, these problems were addressed by applying the remote laser welding method and the quality monitoring method [4].

## 2. EXPERIMENTAL EQUIPMENTS:

Laser welding can be achieved with manipulated the axes of the robot system. Generator used was 1.6kW fiber laser system and the robot system was the 6 axes Industrial robot of payload 130kg. To conduct a basic study of the weldability of the remote laser welding system [5], butt welding and lap welding were conducted with common steel plates and galvanized plates. The beam from the laser generator is transmitter via an optical fiber to the welding head at the end of the robot's arm. The weld joints were inspected and tested for tensile strength to determine the optimal welding parameters. In order to devise a technique of measuring the quality of the laser welding on a real-time-basis, basic experiments were conducted with a technique capable of determining the quality of welding by monitoring plasma and temperature [6]. Pattern welding tests were conducted to examine the accuracy of the entire remote laser welding system. Fig. 1 the developed system of the entire remote laser welding control system [7].



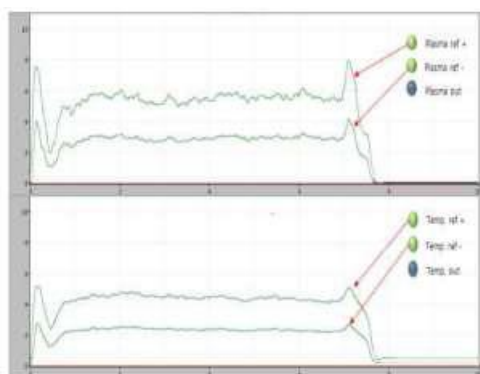
**Fig. 1** The robot-based remote laser welding system.



**Fig.2.** Process sequence of quality monitoring system.

**3. TEST RESULTS:**

Tests were conducted using a Nd:YAG laser and a fiber laser. To monitor weld quality using plasma flux intensity, the initial criteria of plasma intensity - which itself determines the critical weld quality - needs to be determined. When the plasma intensity lies between the maximum and minimum values of the standard range as Fig. 3, the weld quality can be judged to be acceptable.

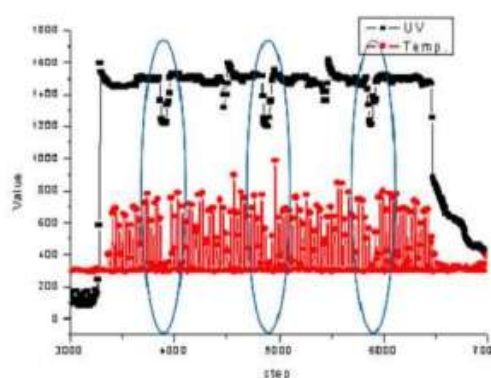


**Fig 3.** The result of quality welding

Fig. 4 shows the results of plasma monitoring test. In the Nd: YAG laser tests, stainless steel specimens were welded at laser powers of 3kW. One UV-type and two IR-type sensors were used in the tests conducted to detect plasma intensity. Three holes measuring 2mm in diameter were machined into steel sheets to test whether it was possible to identify defective parts in which no plasma could be generated due to potential defects in the machining. Also, steel wire measuring 2mm in diameter was attached to the steel sheets - perpendicular to the welding direction - to test whether changes in the generation of plasma caused by changes in the laser's focal length could be detected. The applied welding conditions were laser power of 3kW and a welding speed of 3m/min.



(a) welding specimen



(b) graph of monitoring signal

**Fig. 4** The results of plasma intensity detection using an Nd:YAG laser.

Fig. 5 shows the results of the welding test for optimal welding conditions using a fiber laser. Fig. 6, Fig. 7 and Fig. 8 show the test results of the welding quality monitoring using a fiber laser on the basis of the test results of the Nd:YAG laser. The fiber laser was tested at from 400W to 1,600W power using UV and IR sensors. The results were obtained by scanning the steel sheet many times with the laser scanner of the remote laser welding system. The plasma and temperature signals could be detected at the appropriate values, confirming that real-time-based quality monitoring can be implemented.

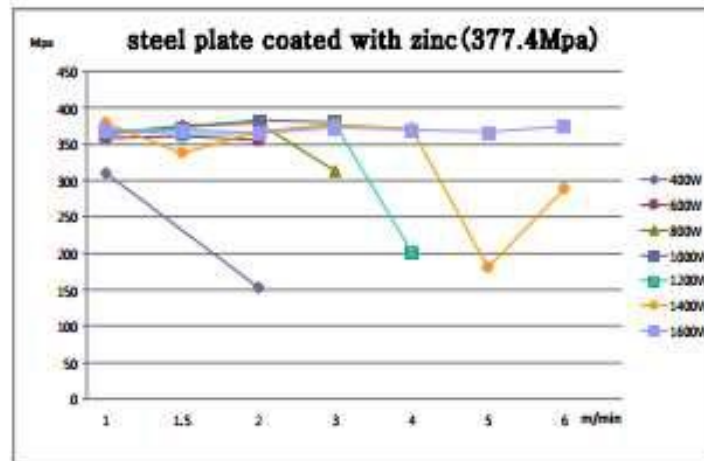
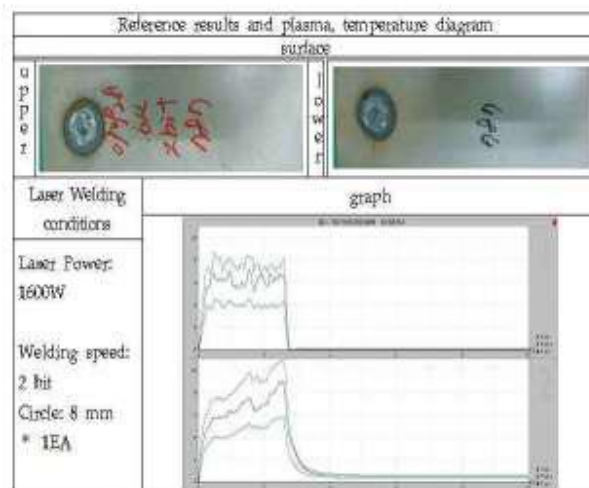
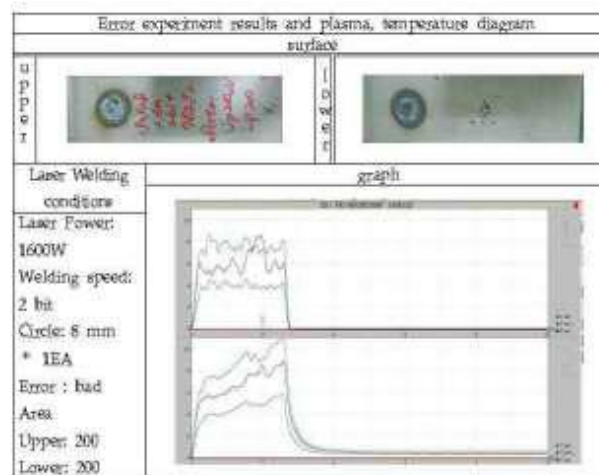


Fig. 5 Results of UTM test in butt joints (steel plate coated with zinc)

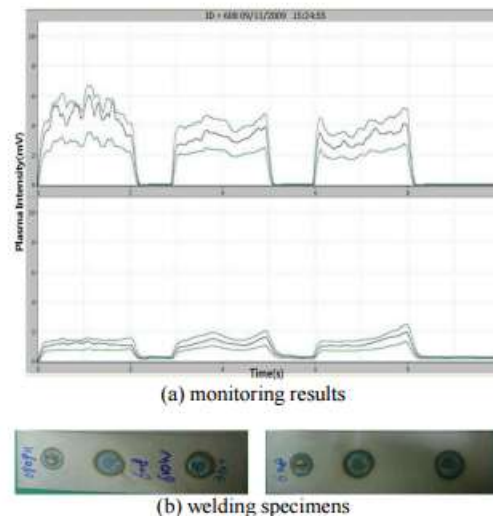


(a) shielding gas; nitrogen, good weld



(b) no shielding; error

Fig.6 The experimental results of quality monitoring during remote laser welding for a circle pattern.



**Fig. 7** Results of quality monitoring during remote laser welding for three circle patterns.

#### 4. CONCLUSION:

A remote laser welding robot system was built on the basis of the interfacing between the laser system and the industrial robot system. Use control laser welding system, butt and lap welding of common and galvanized steel sheets were conducted, and the tensile strength of the samples was tested to determine the optimal welding parameters. The remote laser pattern welding tests were conducted, and the weld joints and defects were analyzed. During the laser welding, the plasma intensity signals were measured and analyzed to assist the development of a technique that enables evaluation of the quality of laser welding in real time. On the basis of the remote laser welding quality tests, the lap welding of galvanized steel sheets and the algorithms for evaluating the quality of laser welding will be tested in further studies.

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