

# **Electrode Deterioration in Resistance Spot Welding of 5182 Aluminium Sheet,** *by I. Lum and Y. Zhou, University of Waterloo, CANADA*

## **Introduction**

Automakers are looking for new ways to improve fuel efficiency. This can be accomplished by using aluminum instead of steel for the body. One of the preferred joining methods for aluminum sheet is resistance spot welding due to the ease of automation, low cost, and it is already readily used for steel. With aluminum, there is the problem of low electrode life and weld inconsistency. In order for the resistance spot welding of aluminum to be feasible in the automotive industry the electrode life must be improved. Work has been done on wear mechanisms when welding aluminum by Dilthey and Hicken but detailed analysis of the progression of deterioration has not been performed. This current work will improve our knowledge of the electrode deterioration.

## **Procedure**

Electrode life tests of Cu 0.2% Zr electrodes were performed with 1.5 mm AA5182 sheet on a MFDC pedestal type spot welder. Welds were made 10 per sample at equal spacing on 50mm x 400mm material. Five overlap shear samples were made on strips 30mm x 120mm and were performed every 50 welds (5 groups of the 10 weld samples) for the first 500 welds and every 100 welds thereafter. Electrode life was established as when the shear strength fell to 80% of the original strength. Electrodes taken at specific weld intervals (i.e. 1, 5, 10... welds) were examined with SEM and EDX in order to analyze the progression of wear.

## **Results**

The wear in the MFDC welding of aluminum was analyzed. The degradation mechanism was determined to be mainly pitting. Mushrooming of the electrode tips was not considered a main factor which is the issue in welding of galvanized steels. The pitting occurs due to alloying of the aluminum with the copper. The thickness of the aluminum copper alloy layer on the electrode face grows rapidly during the first 100 welds then weld consistency starts to be affected due to localized current conduction. The morphology of the pitting on the electrode face was also determined. The pitting starts at the outer edge of the electrode in localized areas. The pitted areas become larger and eventually join to other pitted areas in a ring pattern. This ring then expands with the inside diameter of the ring moving towards the center of the electrode face.

This is important because this means that electrode life can be improved by controlling the alloying as opposed to controlling the mushrooming. One way to control the alloying is with a surface coating on the electrode.

## **Conclusion**

The main electrode degradation mechanism in the resistance spot welding of aluminum sheet is electrode pitting. This pitting occurs as a result of the alloying of the copper with the aluminum and the subsequent alloy breaking off and reforming. The thickness of the alloy layer increases rapidly during the first 100 welds. The pitting develops as a ring on the electrode face. It is recommended that continued work be done with coated electrodes in order to extend electrode life.

## **References**

1. Dilthey, Ulrich and Sven Hicken. "Metallographic investigations into wear processes on electrode during the resistance spot welding of aluminium." *Welding and Cutting*. pp 34-40, January 1998.