



## EFFECTS OF PROCESSING PARAMETERS ON THE EMBRITTLEMENT OF SELF REACTING FRICTION STIR WELDS

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### ABSTRACT

A reduction in mechanical properties was observed in Friction Stir Welded (FSW) Aluminum panels. This reduction in strength has been attributed to Residual Oxide Defect (ROD). It was also found that certain processing parameters would yield these reduced mechanical properties. The strength of FSW Aluminum panels generally decreases with increasing tool travel rate, decreasing rotation speed, and offset of the weld seam to the retreating side of the FSW tool. The microstructure of welds exhibiting these strength reduction as well as welds that behaved as expected were examined to determine microstructural effects of processing parameters. Scanning Electron Microscopy shows that these weld conditions are accompanied by large precipitates along the grain boundary for both Al 2219 and Al 2195.

The primary setup examined in this study was AA 2219 on the advancing side of the weld tool and AA 2195 on the retreating side. Samples were examined which exhibited reduced properties (figure 1) and expected properties (figure 2). The sample which exhibited expected properties showed small highly dispersed precipitates (figure 2). The sample which exhibited reduced mechanical properties showed a high concentration of precipitates along the grain boundaries along the material seam. Welds of AA2219 to AA 2219 were examined as well as welds of AA 2195 to AA 2195 to determine composition effects on the reduction in mechanical properties. Both welds exhibited reduced mechanical properties with accompanying high precipitate density on the retreating side of the weld near the original material seam.

Transmission Electron Microscopy shows the precipitates to be  $\theta$  particles ( $Al_2Cu$ ) and intermetallics in the 2219. T1 ( $Al_2CuLi$ ) and TB particles were identified in the Al 2195 [2]. These precipitates are present before FSW but may undergo coarsening during the process [1]. The large size and heavy distribution of these precipitates,

especially on the advancing side of the weld seam may influence these properties. The most important processing parameter in the formation of these large precipitates was the location of the pin tool with respect to the material seam. The slower relative speed of rotation on the retreating side of the weld may have an affect on the size and distribution of precipitates on that side of the weld. There were no signs of ROD in the samples analyzed in this study. A more complete understanding of these phenomenons is necessary to ensure consistent and predictable weld properties.

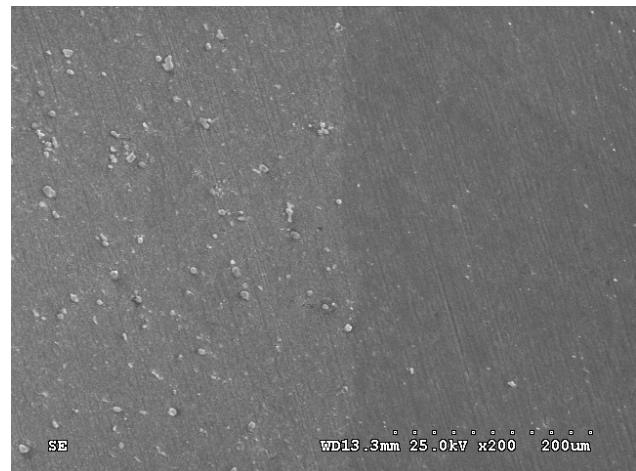


Figure 1- FSW AA 2219 (left) and AA 2195(right) exhibiting reduced mechanical properties.



Figure 2- FSW 2219 and AA 2195 with highly dispersed precipitates exhibiting expected mechanical properties.

### ACKNOWLEDGMENTS

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### REFERENCES

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