

CONTEMPORARY METALLIC MATERIALS

Md Abdul Maleque
Iskandar Idris Yaacob
Zahurin Halim



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Edited by:

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Grain Refining in AISI 430 Ferritic Stainless Steel Welds by Addition of Metal Powder

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Abstract. In the present work, the use of powder replacement technique for grain refinement in AISI 430 Ferritic Stainless Steel (FSS) is discussed. Mixture of aluminum and titanium powders was introduced into the melt pool via TIG torch melting to modify the microstructure and grain size. Quantitative microscopy suggests that the introduction of the mixture of aluminum and titanium can generate grain refinement of around 90% of the base metal and decreased the width of the heat affected zone (HAZ) by about 43% relative to the conventional weld. Hardness profile in the powder treated weld tracks can be 2-3 times higher compared to the conventional weld processed under the same energy input condition. The present attempt provides a simpler procedure for the incorporation of aluminum and titanium into melt pool rather than the conventional argon oxygen decarburization/vacuum oxygen decarburization (AOD/VOD).

Introduction

The more than 300% increase in the price of nickel over the last decade, a major constituent of the austenitic stainless steel, has shot up the cost of the austenitic variety [1]. Consequently, there is a renewed interest in the ferritic variety which contains very little nickel typically less than 4 wt% and thus, is less costly than the austenitic variety. This is further strengthened by the relatively lighter weight of the FSS variety and its better stress corrosion cracking resistance and a high temperature resistance comparable to the austenitics variety [2]. The ferritic variety are, however, quite difficult to fusion weld owing to extensive grain coarsening in the weld region resulting in poorer mechanical properties compared to the austenitic stainless steel processed under the same welding conditions. It is possible to improve mechanical properties in the FSS welds if refined and equiaxed grain structure is generated in the resolidified melt pool and this has been the focused of all grain refinement techniques [3].

Of particular significance is the possibility of generating equiaxed grain structure in the FSS welds via the inoculation of the melt pool with grain refining elements such as titanium, aluminum or combination of these as well as other elements like copper. Some of these elements are added during the steel refining in the AOD/VOD process or via electrode flux