

# CONTEMPORARY METALLIC MATERIALS

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INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

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Edited by:

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## Grain Refinement Practices in Ferritic Stainless Steel Welds

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**Keywords:** Ferritic stainless steel, Fusion weld, Grain refining, Weld stirring, Thermal treatment, Cryogenic cooling, Metal powder

**Abstract.** The various practices for controlling the problems of grain coarsening in fusion welded AISI 430 ferritic stainless steel welds are described. Specifically, such practices as control of welding parameters, melt inoculation, weld pool stirring, and post-weld thermal treatment are discussed. These discussions are reinforced with the treatment of emerging techniques for grain refinement such as: (i) the incorporation of grain refining element via metal powder preplacement and (ii) cryogenic cooling.

### Introduction

The ferritic stainless steel variety is acknowledged as an attractive alternative to the ubiquitous austenitic variety on account of its lower economics coupled with better stress corrosion cracking resistance in both acidic and alkaline environments. It equally has comparable yield strength and oxidation resistance with the austenitic variety [1, 2]. Furthermore, it has a lower specific weight relative to the austenitic grade and as such it provides a relatively better green index to the austenitic variety [3].

However, the challenge with the ferritic stainless steel variety particularly the medium chromium grade typified by AISI 430 is that it is quite difficult to fusion weld without any defect. Fusion welding of the grade is accompany with many difficulties such as grain coarsening, formation of high carbon grain boundary martensite and poor resistance to solidification cracking. These problems lower the mechanical properties of the weld particularly, the ductility and toughness and has contributed to the limitation in the extension of the ferritic grade to high end structural application.

In order to address these challenges, several modifications have been adopted for the fusion welding of the ferritic stainless steel in the last few decades. Some of these techniques include control of welding parameters, modification of chemical composition of the base metal, adding inoculants to the electrode coatings, post-weld thermal treatment, weld pool