SPC4. Alloy Development Of A Robust Filler Metal For Sass Alloys

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Introduction

The superaustenitic stainless steels (SASS) alloy Al-6XN has been selected by the U.S. Navy for incorporation into the new Advanced Double Hull (ADH) design for combatant ships for their superior mechanical and corrosion-resistance properties, in addition to a non-magnetic character that will eliminate detection by mines. The inclusion of SASS alloys has been hindered by difficulties encountered during welding. Research into the development of a new robust filler metal for the alloy AL-6XN that will improve weldability and corrosion-resistance while reducing costs relative to current filler metal solutions will expand the range of possible applications for SASS alloys.

Technical Approach & Results

Thermodynamic modeling of the Fe-Ni-Cr-Mo quaternary phase diagram was performed in order to locate a range of compositions over which a solidified ferritic stainless steel will transform into a fully-austenitic structure. Solidifying as ferrite will help eliminate or minimize solute concentration gradients, which will improve the corrosion-resistance properties and reduce solidification cracking susceptibility of weld fusion zones. The solid-state transformation will produce the non-magnetic austenite phase required of the application. Weld buttons of the compositions found via computer simulation were constructed using an arc button melter from elemental powder mixtures. Microstructural characterization was conducted in order to identify the presence of residual ferrite. Microsegregation profiling was also performed to measure the distribution of molybdenum, an element crucial to corrosion-resistance properties. These results will be discussed in terms of selecting filler metal compositions for improved weldability and corrosion resustance of alloy AL6XN.

Conclusions

Novel filler metals to be formed in this project will have a direct and immediate use in the arc-welding of ADH combatant ships constructed of the SASS alloy AL-6XN. However, the robust filler metal that will be developed will have greater benefits for industry and the welding community at large. Applications exist that would certainly benefit from the use of a SASS alloy, but were not considered since a low-cost filler metal with high weldability was not available. The proposed technique would not require new tooling, so impacts on the welding industry could be rapid.