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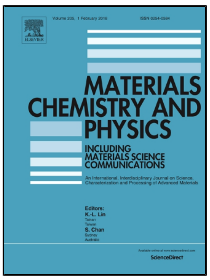

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Influence of Si on Sigma Phase Precipitation and Pitting Corrosion in Superaustenitic Stainless Steel Weld metal

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Abstract

In this study, we investigated the effect of Si on the precipitation of the sigma phase in super austenitic stainless steel welds. The Scheil module solidification, partition coefficient and activity were calculated using the thermo-calc software to study the thermodynamics of the precipitation behavior of the sigma phase during solidification of the weld metal. The fraction and average size of the sigma phases significantly increased with increasing Si content in the welds, which consisted of γ-dendrite and inter-dendritic sigma phases. Scheil solidification showed that the formation temperature range of the sigma phase increased with increasing Si content. Also, partition coefficient of Cr and especially Mo and Si substantially decreased under the L-γ solidification with addition of Si. And it resulted in increase of Cr, Mo and Si contents in the sigma phases. The activity of Mo rose sharply with increasing Si, which caused an increase in precipitation due to the fundamental elements of the sigma phase. Corrosion test results showed that pitting was sensitive to an increase in the Si assisted sigma phase precipitation.

1. Introduction

Nuclear power plants have recently received renewed attention in light of increasing global energy consumption. The construction of nuclear facilities requires steel products with high mechanical properties and excellent corrosion resistance [1, 2]. Therefore, super austenitic stainless steels that contain more than 6 wt% molybdenum (Mo) have been used in various industries requiring high corrosion resistance. These steels have excellent pitting corrosion resistance due to their high Cr, Mo, and N content [3-6]. Generally, the pitting corrosion equivalent