Influences of boron and silicon in insert alloys on microstructure and isothermal solidification during TLP bonding of a duplex stainless steel using MBF-35 and MBF-30

Xinjian Yuan[a], Myung Bok Kim[b], Chung Yun Kang[a,1]

[a]Department of Materials Science and Engineering, Pusan National University, Busan, 609-735, Republic of Korea

[b]National Core Research Center (NCRC) for Hybrid Material Solution, Pusan National University, Busan, 609-735, Republic of Korea

Abract

The influences of B and Si in the filler metals on microstructure and isothermal solidification during transient liquid-phase (TLP) bonding of a nitrogen-containing duplex stainless steel with MBF-30 (Ni–4.5wt.%Si–3.2wt.%B) and MBF-35 (Ni–7.3wt.%Si–2.2wt.%B), were studied at the temperature range of 1030-1090°C with various times from 60 s to 3600 s under a vacuum of approximately 10^{-5} Torr. In case of the former, BN, Ni_3B and Ni_3Si precipitates were formed in the bonding region. BN and Ni_3Si secondary phases were present in the joint for the latter case. The formation of Ni_3B within the joint centerline is dependent on B content. The morphology of Ni_3Si is dominated by Si concentration. A difference between the times for complete isothermal solidification obtained by the experiments and the conventional TLP bonding diffusion model was observed when using MBF-35. According to the simulated results, the isothermal solidification completion time for MBF-35 case was smaller than that in MBF-30. However, this experimental value obtained using MBF-35 was notably larger than that obtained using MBF-30. Isothermal solidification of liquid MBF-30 is controlled by the first isothermal solidification regime dependent on B diffusion model, whereas that of liquid MBF-35 experiences two isothermal solidification regimes and is mainly controlled by the second isothermal solidification dependent on Si diffusion model. In addition, only if Si content exceeds a critical value, the slower 2nd solidification regime will commence.

Keywords: TLP bonding; Duplex stainless steel; Boron; Silicon; Microstructure; Isothermal solidification

[1]Corresponding author.Tel.:+82-51-5102428;Fax:+82-5183360.
E-mail address: Kangcy@pusan.ac.kr (Chung Yun Kang).