CHAPTER 5

Conclusions and Future Work

5.1 Base Metals

5.1.1 Chemical Composition

Chemical and phase composition of 200 and 300 series base metals in the present work are generally in the range of standard specification. of the selected austenitic stainless steels. Though, chromium content in AISI 202 was lower than the standard range and can be a major cause of its inferior corrosion resistance and mechanical properties.

5.1.2 Corrosion Properties

- Pitting Corrosion Resistance:

Calculated corrosion potential (E_{corr}) and protection potential (E_b-E_p) from Tafel plots for all ASSs were in a comparable range. Pit morphology observation indicated that grade 300 series ASSs had slightly better pitting corrosion resistance as their pit depth and width were more shallow and narrower than those of the 200 series. Nevertheless, pit distribution on corroded surface is comparable.

- Degree of Sensitization:

Criteria for inspection after DOS tests were both morphology observation and calculation from double loop electrochemical potentiokinetic reactivation (DLEPR). The 300 series showed mild sensitisation with step structure, while the modified 200 series showed slightly more sensitisation with dual structures. Lack of chromium content in AISI 202 can be the reason for inferior DOS.

5.1.3 Mechanical Properties

AISI 304 and AISI 304L exhibited higher %elongation. ASSs with higher Mn or Cr had higher trength and less %elongation than those of 300s series. Trend of MVH measurement was similar to those obtained from tensile test.

5.2 PCGTAW Austenitic Stainless Steels

5.2.1 Welding Process Control Parameters

Thermal profile plots showed the effect of higher heat input when welding current was increased. Temperature gradient between distance from WCL perpendicular to weld torch moving was found to be around 300 ^{o}C and still possible to initiate minor phase segregation if cooling rate is inappropriate.

The amount of nitrogen dissolved in weld metal tended to increase but not entirely. Some proportion of nitrogen dissolved in weld metal of PCGTAW 201-2M and had a beneficial effect in controlling weld bead and complete depth penetration so that good weld integrity can be achieved. Distortion became less when welding current was increased, but increasing the amount of nitrogen did not help to lessen the distortion in weld pool of AISI 202. No trace of hot crack found in the observed area under scanning electron microscope.

5.2.2 Weld Structure Prediction

Weld structure prediction suggested the existing of FA weld solidification mode in all ASSs. δ-ferrite calculation indicated high amount of FN after welding in the case of modified 201-2M, whereas expected FN of other ASSs were fairly similar. Microstructure type in weld metal was type B.

5.2.3 Pitting Corrosion Resistance

At welding current 130 A, nitrogen had alleviated corrosion potential of PCGTAW 201-2M toward noble potential comparable to PCGTAW AISI 304 and AISI 304L. PCGTAW AISI 202 exhibited inadequate corrosion resistance and nitrogen could not help to improve its corrosion resistance with regarding to its relatively low chromium concentration.

5.2.4 Degree of Sensitization (DOS)

Nitrogen at 5 and 10 vol.% addition in shielding gas reduced intergranular corrosion cracking in cases of AISI 304, AISI 304L and 201-2M. Also, the DOS test of 201-2M was improved when shielding gases contain partially mixed nitrogen. Therefore, at welding current 130 A with 5 vol.% nitrogen addition in shielding gas, corrosion resistance of PCGTAW AISI 201-2M can be improved to the level comparable the 300s series

5.2.5 Mechanical Properties

Nitrogen dissolved in weld metal from shielding gases during the weld fabrication also helped to improve tensile strength at the optimum welding parameters. No hot crack trace or large particles remained in dimples of weld fracture surface after performed tensile test. Nitrogen addition at at the applied welding current of 130 A led to uniform MVH along the cross-section of weld bead contour in case of PCGTAW 201-2M.

Overall, 201-2M has a potential to substitute of AISI 304 grade, if economic reason is concerned.

5.3 Future Work

1. Further study on 201-2M under different working environment parameters e.g. salinity, acidity, temperature and workload, should be performed.
2. Passive film formed in PCGTAW 201-2M during the repassivation kinetic should be further studied by XPS technique.
3. Phase identification of carbides at grain boundary should be performed.