Thesis Title	In-situ Phase Transformation Monitoring during Welding of Metals based on Single Sensor Differential Thermal Analysis (SS-DTA) Technique
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Abstract

Single Sensor Differential Thermal Analysis (SS-DTA) is an effective non-destructive testing technique for studying and detecting the phase transformations and structural changes in materials. It uses only one temperature sensor to measure the temperature in a particular point of interest in the material during actual and simulated thermal processing of the material. SS-DTA compares the temperature recorded in a tested specimen against a reference thermal profile which is traditionally generated by optimising the parameters in the thermal cycle equations. The aim of this work was to develop a data-modelling-based SS-DTA technique which generates a reference curve by using the piecewise linear approximation technique. In contrast to the traditional SS-DTA, the developed technique does not need the knowledge of processing conditions. The segment width of the piecewise linear reference curve was automatically selected and found that the appropriate values of segment width could be ranging from 1.25 – 1.75 seconds. The differential temperature profiles over possible phase transformation temperatures of the tested material were then compared with an adaptive threshold which requires a designed parameter, the lambda. The performance of the developed SS-DTA technique was evaluated by investigating the phase transformations of several

welded metals, including stainless SUS321, zinc alloy, ER309 and ERCoCr-A, alloy 617, and incoloy 800H. The results indicate that the adaptive threshold method could give an accuracy up to 95% when the lambda ranging from 2.2 – 2.4.

Keywords: Single Sensor Differential Thermal Analysis Technique/ Heat Effected Zone / Detect Phase Transformation / Thermal Analysis