THE THERMOGRAPHIC NONDESTRUCTIVE EVALUATION OF IRON ALUMINIDE GREEN SHEET

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Abstract

The recent development of manufacturing techniques for the fabrication of thin iron aluminide alloy sheet requires advanced quantitative methods for on-line inspection. An understanding of the mechanisms responsible for flaws and the development of appropriate flaw detection methods are key elements in an effective quality management system. The first step in the fabrication of thin FeAl alloy sheet is the formation of a green sheet by cold rolling FeAl powder mixed with organic binding agents. The green sheet composite has a bulk density, which is typically less than about 3.6 g/cc. The finished sheet, with a density of about 6.1 g/cc, is obtained using a series of process steps involving binder elimination, densification, sintering, and annealing. Non-uniformities within the green sheet are the major contributor to material failure in subsequent sheet processing and the production of non-conforming finished sheet. The production environment and physical characteristics of the composite provide for unique challenges in developing a rapid nondestructive inspection capability. The method must be non-contact due to the fragile nature of the composite. Limited access to the material also demands a one-sided inspection technique. An active thermographic method providing for 100% on-line inspection within an industrial process has been developed. This approach is cost competitive with alternative technologies, such as x-ray imaging systems, and provides the required sensitivity to the variations in material composition. The mechanism of flaw formation and the transformation of green sheet flaws into defects that appear in intermediate and finished sheet products are described. A mathematical model, which describes the green sheet heat transfer propagation in the context of the inspection technique and the compact heterogeneity, is also presented. The potential for feedback within the production process is also discussed.