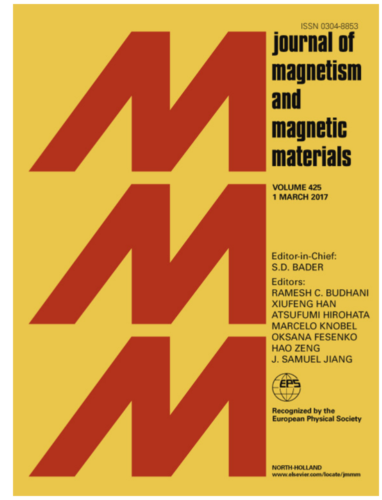

Characterizing the magnetic memory signals on the surface of plasma transferred arc cladding coating under fatigue loads

Haihong Huang, Gang Han, Zhengchun Qian, Zhifeng Liu

PII: S0304-8853(17)31037-5
DOI: http://dx.doi.org/10.1016/j.jmmm.2017.07.067
Reference: MAGMA 62998

To appear in: *Journal of Magnetism and Magnetic Materials*

Received Date: 28 March 2017
Revised Date: 8 June 2017
Accepted Date: 20 July 2017

Please cite this article as: H. Huang, G. Han, Z. Qian, Z. Liu, Characterizing the magnetic memory signals on the surface of plasma transferred arc cladding coating under fatigue loads, *Journal of Magnetism and Magnetic Materials* (2017), doi: http://dx.doi.org/10.1016/j.jmmm.2017.07.067

Characterizing the magnetic memory signals on the surface of plasma transferred arc cladding coating under fatigue loads

Haihong Huang*, Gang Han, Zhengchun Qian, Zhifeng Liu

School of Mechanical Engineering, Hefei University of Technology, Hefei 230009, China

* The corresponding author: Haihong Huang

E-mail: huanghaihong@hfut.edu.cn, Office: 86-0551-6290135

ABSTRACT: The metal magnetic memory signals were measured during dynamic tension tests on the surfaces of the cladding coatings by plasma transferred arc welding and the 0.45% C steel. Results showed that the slope of the normal component $H_p(y)$ of magnetic signal and the average value of the tangential component $H_p(x)$ reflect the magnetization of the specimens. The signals increased sharply in the few initial cycles; and then fluctuated around a constant value during fatigue process until fracture. For the PTA cladding coating, the slope of $H_p(y)$ was steeper and the average of $H_p(x)$ was smaller, compared with the 0.45% C steel. The hysteresis curves of cladding layer, bonding layer and substrate were measured by vibrating sample magnetometer testing, and then saturation magnetization, initial susceptibility and coercivity were further calculated. The stress-magnetization curves were also plotted based on the J-A model, which showed that the PTA cladding coating has smaller remanence and coercivity compared with 0.45% C steel. The microstructures of cladding coating confirmed that the dendrites structure and second-phase of alloy hinder the magnetic domain motion, which was the main factor influencing the variation of magnetic signal during the fatigue tests.

Keywords: Plasma transferred arc welding; Metal magnetic memory; Cladding coating; Vibrating sample magnetometer testing; Fatigue.

1 Introduction

Plasma transferred arc (PTA) welding is an important and rapidly growing method of surface modification technology. The advantages of this method include intensive energy density, excellent arc stability, high weld speeds, low thermal distortion of the parts, low-cost of equipment and low environmental impact [1]. Dilution, which is the percentage of the base material melted into the coating, is within 5%–10%. In additional, the cladding coating has a fine microstructure because of its high cooling rates, excellent shape constancy of the welding, and high adhesion between the coating and substrate [2-3].

Several studies were conducted on PTA welding. These studies evaluated the performance of this composite material in terms of hardness, micro cracks and other mechanical properties. Moreover, it is also quite important and useful to study the physical and mechanical properties after remanufacturing (repairing and rebuilding) using PTA welding method. These properties including crack behavior induced by residual stress and temperature gradient and impact of PTA process parameters on tensile properties and microstructure. Veinthal et al. analyzed the relation between the arc energy and the surface fatigue wear behavior of Fe-Cr-C powder [4]. Their study showed that different cooling time leads to differences in microstructure and formation of residual stresses and surface cracks from surface fatigue wear testing. García-Vázquez et al. deposited nickel-base alloys on D2 steel and evaluated the metallurgical features on the weld beads/substrate