MASTER'S THESIS

Minimally destructive and multi-element analysis of stainless steel by ArF laser-induced plume emissions

Lau, Sai Kin

Date of Award:
2013

Minimally Destructive and Multi-Element Analysis of Stainless Steel by ArF Laser-Induced Plume Emissions

LAU Sai Kin

A thesis submitted in partial fulfillment of the requirements

for the degree of

Master of Philosophy

Principal Supervisor: Prof. CHEUNG Nai Ho

Hong Kong Baptist University

January 2013

Abstract

ArF laser induced plume emissions spectroscopy is an analytical technique previously developed by our group. We extended it to the target matrix of stainless steel. Conventional laser-excited atomic fluorescence excites only one transition at one laser wavelength. Our technique induced numerous analytes including Mn, Si, Fe, Nb, Cr, Mo, Ni, and Cu to fluoresce simultaneously at a single excitation wavelength of 193 nm. When compared to laser-induced breakdown spectroscopy, orders of magnitude improvement in signal-to-noise ratios was achieved under the same condition of minimal sample destruction. The mass detection limit of Mo was about 1 femto-mole. Two stainless steel alloy types, AISI 304 and AISI 316, were readily differentiated by single-shot sampling at ablation and etch rates of about 13 pg and 2.5 nm per pulse, respectively. Time-resolved spectroscopic studies showed that photo rather than thermal excitation was the dominant excitation mechanism.

Table of Contents