

MASTER'S THESIS

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

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

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**A thesis submitted in partial fulfillment of the requirements
for the degree of
Master of Philosophy**

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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

Declaration	.....	i
Abstract	.....	ii
Acknowledgements	.....	iii
Table of Contents	.....	v
List of Tables	.....	viii
List of Figures	.....	ix
Chapter 1 Introduction	.....	1
1.1 Background and motivation	.....	1
1.2 Objective	.....	2
1.3 Organization of the thesis	.....	3
Chapter 2 Background and principles of ArF laser induced plume emissions	.....	5
2.1 Overview of LIBS	.....	5
2.2 From LIBS to ArF laser induced plume emissions	...	8
2.2.1 LIBS to LEAF	.....	8
2.2.2 LEAF to ArF laser induced plume emissions - Universal excitation by 193nm photons	.....	9

2.3	Aluminum alloy to stainless steel	12
2.4	ArF probe versus LA-ICP-MS	19
2.5	Summary	21
Chapter 3	Experimental	23
3.1	Sample Preparation	23
3.2	ArF laser induced plume emissions measurements	25
3.3	Sample destruction measurements	33
3.3.1	Surface micrographs	33
3.3.2	Mass removed and etch depth	33
3.4	Summary	36
Chapter 4	Results and discussion	37
4.1	Extent of sample destruction	37
4.2	Universality of the technique	40
4.3	Sensitivity of the technique	51
4.4	Time evolution of spectral features	54
4.5	Summary	57
Chapter 5	Conclusion	58

Appendix	.....	61
References	.....	66
Curriculum Vitae	.....	70