

## 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.

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