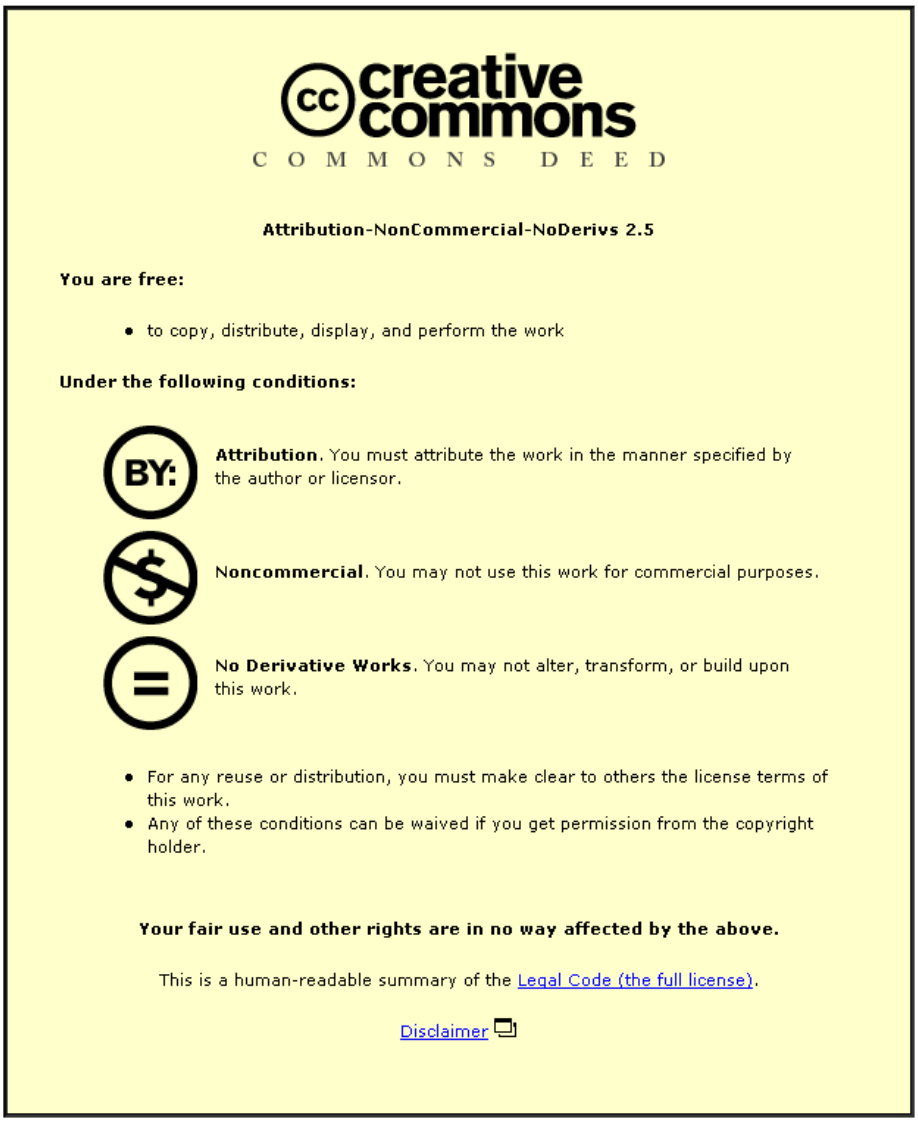

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COLLECTED PAPERS ON THE USE OF INDUCTIVELY COUPLED ANNULAR PLASMAS IN ATOMIC SPECTROSCOPY

Submitted for the degree of Doctor of Science
Loughborough University of Technology
October 1991

Certificate of Originality

Much of the work described in this collection of papers was carried out whilst I was employed by Albright and Wilson Ltd., as Head of Analytical Research; consequently, the papers have joint authorship. Subsequent studies were made at Loughborough University of Technology, initially with a Research Assistant, and latterly with the assistance of postgraduate students.

In all these studies I originated the work, directed it, and in many instances was involved in the experimental work.

Introduction

The author's international reputation as an atomic spectroscopist commenced with the publication of the first paper, and subsequent patents, describing the use of the inductively coupled annular plasma as an emission source. Prior to this he had achieved recognition for other innovative papers [3-7, 10] in the field of analytical chemistry. The accompanying collection of papers refer to the period after the author's entry into the field of atomic spectroscopy with high temperature plasmas.

The first paper is an account of the preliminary investigations into the use of high-pressure plasmas as emission sources. In the second paper the results of some of the work on these sources in the intervening years, culminating in a completely automated system, are presented. There follows a paper in which interference effects in plasma spectrometry are discussed and the important conclusion is made that such effects can in some circumstances be attributed, by a satisfactory correlation between signal and solution properties, to the aspiration and nebulising system. As part of a systematic investigation into the properties of inductively coupled plasmas the next paper describes calorimetric studies which were made in order to determine the power in the plasma as a function of applied plate kVH. The next paper forms part of the author's Ph.D. thesis and is a tutorial discussion, presented in an original way, of the sufficient criteria to be used for the unequivocal comparison of plasma torches as emission sources. Such a comparison of argon cooled and nitrogen cooled plasma torches is made in the following paper which also forms part of the same thesis. (This work was carried out whilst the author was employed at Albright and Wilson Ltd., but registered at Loughborough University of Technology for a Ph.D. degree).

The paper which follows the above is a description of the use of flow injection analysis with plasma spectrometry, together with suggestions for its further use. This paper was the first recorded account of the coupling of these two techniques.

The next series of papers concerns the use of inductively coupled plasmas as line sources and as atomisers in atomic fluorescence spectrometry and marks a change in the author's interest in the use of plasmas. The first of these papers is a description of the preliminary work on an atomic fluorescence spectrometer utilising a high power plasma as a source and a low power plasma as an atomiser. There follows a short paper on the use of organic additives in plasma atomic fluorescence spectrometry as a means of enhancing the fluorescence emission from elements which form refractory oxides. This paper is followed by a "mid-term" report of the work carried out on the system, which indicated the remarkable freedom from spectral interference which the technique of atomic fluorescence possesses. This paper was also believed to be the first study of non-resonance transitions using a dual-plasma atomic fluorescence system.

To complete the investigation into the use of plasmas in atomic fluorescence a study was made of chemical and ionisation interference effects and this is described in the next paper. However, before this latter study could be made it was necessary to make a detailed study of two optimisation techniques which are commonly used in plasma work and this study is described in the penultimate paper. In the final paper inductively coupled plasmas are compared with more conventional sources, in this instance, boosted discharge hollow cathode lamps.

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