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Biological application of laser induced breakdown spectroscopy technique for determination of trace elements in hair

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Abstract
Analysis of trace elements in mammalian hair has the potential to reveal retrospective information about an individual's nutritional status and exposure. As trace elements are incorporated into the hair during the growth process, longitudinal segments of the hair may reflect the body burden during growth. Using LIBS technique, Na, K, Ca, Mg, Si, Fe, Pb and Zn were detected in a single strand of horse hair. The results obtained through LIBS technique on hair samples were compared with the traditional technique (AAS) on digested acidified solution of the same samples. The effects of the experimental parameters on the emission lines were studied and the local thermodynamic equilibrium (LTE) in produced plasma was investigated. The transient plasma condition was verified at specific time region (1500-2000nsec) in the plasma evolution corresponding to its dynamic expanding characteristic. The relative mass concentrations of Fe and Zn were calculated by setting the concentration of C as the calibration. The information obtained from the trace elements' spectra of horse hair in this study substantiates the potential of hair as a biomarker.

Keywords: Hair; LIBS; Trace elements

1. Introduction

Every part of the mammalian body contains at least few atoms of every stable element in the periodic table. A large number of these elements are found in detectable amounts in biological samples such as blood, urine and hair. In particular, hair contains higher concentration of many of these elements. Trace elements accumulate in hair at concentrations that are generally higher than those present in other biological samples which provide a continuous record of nutrient mineral status and exposure to heavy metal pollutants as well as a probe of physiological functions. Hair has several characteristics of an ideal tissue in that it is painlessly removed, normally discarded, easily collected and its contents can be analyzed relatively easily [1].

Hair tissue mineral analysis (HTMA) is one of the most widespread techniques for the screening of metal poisoning in individuals exposed to occupational or environmental risks. In addition to its potential as a biomarker, the analysis of hair samples has several advantages. Hair is easily collected and does not require any special storage or preservation. Most recently, this analysis has been extended to the analysis of non-poisonous elements in hair since it is believed that the amount of mineral content of the hair can give an insight of the general health condition of the