LASER-INDUCED BREAKDOWN SPECTROSCOPY (LIBS): AN
INNOVATIVE TOOL FOR STUDYING BACTERIA

by

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DEDICATION

I would like to dedicate my dissertation to my wife, my children Amr, Sarah and Muhammad, my mother, my Father, and my brothers and sisters, for their love, patience, and support.
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Chapter 1

Introduction

Bacteria, both pathogenic and non-pathogenic, are the omnipresent companions to human existence. They live all around us and within us. In fact, it was found that the number of bacterial cells that exist in an average healthy adult is estimated to outnumber human cells 10 to 1.\(^1\) Due to their impact on so many aspects of human health and safety, different approaches have been investigated in order to develop biosensing technologies that can be used as robust and rugged tools for the positive identification of bacteria in real-time.\(^2\)

Such technology is urgently needed to identify bacteria in clinical samples at the time when a clinical sample of blood, urine or sputum is obtained, particularly if this could be done with little or no sample preparation. Currently, no such technology exists to fill this role. This ability to identify the bacteria rapidly and onsite would allow doctors to successfully diagnose the disease and then initiate the proper treatment without waiting for offsite lab results to be returned. In addition to that, the integration of new technology could play an important role in the epidemiology of outbreaks of illness such as tuberculosis (TB),\(^3\) not only in the treatment of patients, but also in the tracking of the TB bacteria to help identify the source of infection and to keep the infections from spreading. An accurate rapid identification of bacteria could also minimize the use and overuse of broad spectrum antibiotics. The consequences of such overuse and abuse of broad spectrum antibiotics include not only excessive costs of billions of dollars, but also has led to the ever-increasing emergence of drug resistant bacteria.

This type of new technology would be important not only clinically, but could provide an immediate identification of dangerous pathogens in certain types of foods such as meats,