

Preface

This book is meant as comprehensive source of the fundamentals and applications of laser-induced breakdown spectroscopy (LIBS). It provides a systematic introduction to the principles, the dominant process parameters, and the instrumental components for LIBS. The effect of multiple pulses on material ablation, plasma dynamics, and plasma emission is presented in detail. The double-pulse approach is described, and the underlying physics by integral as well as temporally and spatially resolved plasma diagnostics is clarified. A heuristic plasma modeling allows to simulate complex experimental plasma spectra. These methods and findings form the basis for a variety of applications to perform quantitative multielement analysis with LIBS.

These application potentials of LIBS have really boosted in the last years ranging from bulk analysis of metallic alloys and nonconducting materials, via spatially resolved analysis and depth profiling covering measuring objects in all physical states: gaseous, liquid, and solid. Dedicated chapters present LIBS investigations for these tasks with special emphasis on the methodical and instrumental concepts, as well as the optimization strategies for a quantitative analysis.

Requirements, concepts, design, and characteristic features of LIBS instruments are described covering laboratory systems, inspection systems for inline process control, mobile systems, and remote systems.

Based on this applied research and development, LIBS was pushed forward significantly achieving limits of detection for quantitative trace element determination and measuring frequencies not achieved so far. Industrial applications of LIBS systems are presented demonstrating the benefits of inline process control for improved process guiding and quality assurance purposes. Among these the identification testing of pipe fittings with LIBS impressively shows the first routine application established where more than five million products were tested automatically in a production line within a period of less than 2 years.

The author moved into this challenging subject in the early nineties and the present book has grown out of work performed at the Fraunhofer-Institut für Lasertechnik (ILT) in Aachen, Germany. Thanks are due to many colleagues and students at ILT as well as former coworkers who continued their career in

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