

Preface

LASER – probably ever since this acronym has been invented for “Light amplification by stimulated emission of radiation” it generates fascination. The light of the special kind, monochromatic, extremely focusable, at first inspired science but increasingly is seen paving the road towards global relevant innovations in our modern world.

The paradigm that associates laser with a device is changing. Laser radiation is energy in one of its purest forms rather comparable with electricity. This also holds in terms of the quality of energy, i.e. the entropy of both forms of energy approaches zero in the limit, which means practically, it can be transformed into other forms of energy with maximum efficiency. Laser energy however is characterized by even higher degrees of freedom and thus can be adopted even more efficiently and more effectively to the demands of processes considered. Especially the extreme possibilities of modulation in time, space and frequency enable exact adoption to the demands of process technology (Fig. 1).

As a credo we came to the title of this book “Tailored Light”. Consequently laser technology can be applied in a vast field of applications e.g. cutting, drilling, joining, ablation, soldering, hardening, alloying, cladding, polishing, generating and marking. We see applications in products of all relevant areas of our society, in mobility, energy, environment, health or production technology in general. The actual trend shows an increasing number of new applications every year. Thus the technology is seen to provide the momentum for innovations which are necessary to meet the global challenges.

The roots of this book can be found in a scriptum of a laser course at RWTH Aachen about 12 years ago. The content is based on part 2 “Laser Applications” and has been completed with actual comments and examples of relevance for the innovative engineer. The book splits up in two parts: Part 1: Fundamentals of laser materials processing, where the relevant physical phenomena are displayed, which form the basis of laser material processing by laser radiation. In part 2, Applications, a brief survey on the most important laser beam sources is given. Chapters 10–17 contain applications in manufacturing and production technology. Broadly diffused and practically integrated applications can be found as well as new perspectives like

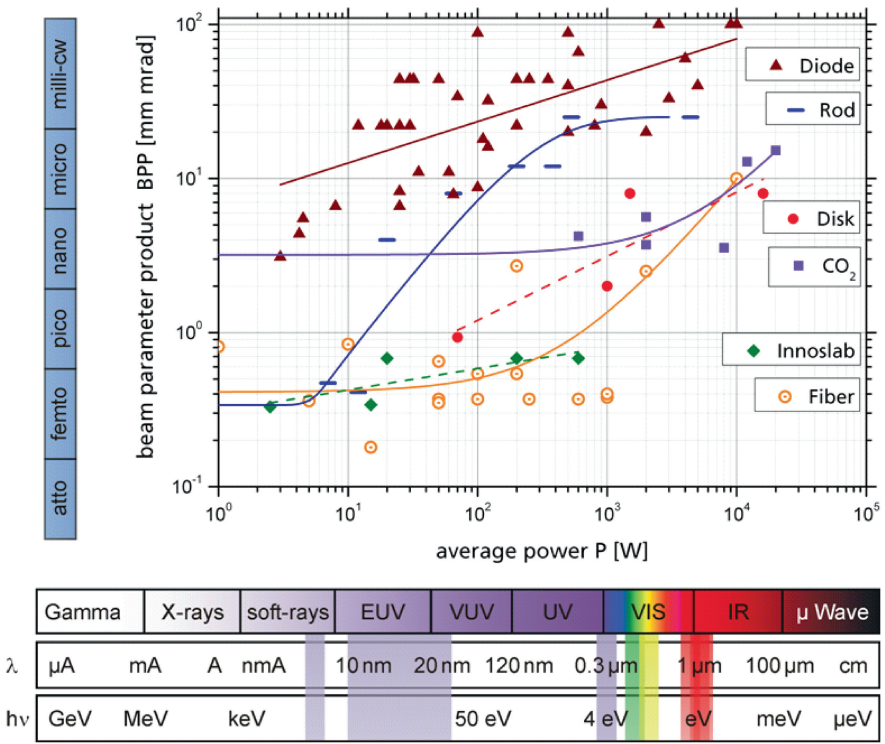


Fig. 1 Commercially obtainable lasers (R&D laser systems are not shown in the graph) are available from continuous operation (cw) down to pulse lengths below fs (10^{-15} s) and wavelengths from the far infrared (IR) down to a few nanometers. The spatial beam quality (focussability) is increasing continuously over the years in both, the temporal and the frequency spectrum

laser generating, laser polishing or laser cleaning. On top, Chap. 19 gives a survey on relevant processes in laser metrology.

The book has been compiled from contributions of many scientists in the Fraunhofer-Institute for Laser Technology (ILT) in Aachen and the University chair for Laser Technology at RWTH Aachen University (LLT). The generalized results from industrial and fundamental research projects have been included together with actual examples from real world industrial applications and thus shall close the loop from application oriented fundamentals to industrial and societal relevance.

Special thanks deserves Dr. rer. nat. Rolf Wester, who formulated in precise and comprehensive manner part 1 of the book “The Fundamentals”. Also Dr. rer. nat. Torsten Mans deserves special mentioning, because his coordination and editing of the second part of this book was a tremendous contribution absolutely necessary in combining the knowledge of so many. The authors of the individual chapters deserve special acknowledgement. Here they are listed in alphabetical order:

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Should the reader feel the wish for further, more intense consideration of individual parts of the content he is welcome to contact the individuals. This may concern a desire for clarification of fundamental questions and in depth explanation as well as adoption of that content to current questions and new applications. In this manner we want to contribute to global competitiveness and improve our role in applying laser technology as competent partner of the innovators.

Aachen
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