

Heat and  
Mass Transfer

C. Baumgarten

# Mixture Formation in Internal Combustion Engines

 Springer

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*Series Editors: D. Mewes and F. Mayinger*

Carsten Baumgarten

# **Mixture Formation in Internal Combustion Engines**

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## Preface

A systematic control of mixture formation with modern high-pressure injection systems enables us to achieve considerable improvements of the combustion process in terms of reduced fuel consumption and engine-out raw emissions. However, because of the growing number of free parameters due to more flexible injection systems, variable valve trains, the application of different combustion concepts within different regions of the engine map, etc., the prediction of spray and mixture formation becomes increasingly complex. For this reason, the optimization of the in-cylinder processes using 3D computational fluid dynamics (CFD) becomes increasingly important.

This book may serve both as a graduate level textbook for combustion engineering students and as a reference for professionals employed in the field of combustion engine modeling.

The research necessary to write this book was carried out during my employment as a postdoctoral scientist at the Institute of Technical Combustion (ITV) at the University of Hannover, Germany. The text was accepted in partial fulfillment of the requirements for the postdoctoral Habilitation-degree by the Department of Mechanical Engineering at the University of Hannover.

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## Nomenclature

## Abbreviations

|      |                                 |
|------|---------------------------------|
| ATDC | after top dead center           |
| B    | Spalding transfer number        |
| BMEP | break mean effective pressure   |
| BTDC | before top dead center          |
| CAI  | controlled auto-ignition        |
| CAN  | controlled auto-ignition number |
| CFF  | critical flow factor            |

|      |  |
|------|--|
| CFD  | computational fluid dynamics                   |
| CI   | compression ignition                           |
| CN   | cetane number,<br>cavitation number            |
| CR   | compression ratio,<br>common rail              |
| DDB  | droplet deformation and break-up model         |
| DDM  | discrete droplet model                         |
| DI   | direct injection                               |
| DISI | direct injection spark ignition                |
| DNS  | direct numerical simulation                    |
| EGR  | exhaust gas recirculation                      |
| GDI  | gasoline direct injection                      |
| HCCI | homogeneous charge compression ignition        |
| HTO  | high temperature oxidation                     |
| ICAS | interactive cross-sectionally averaged spray   |
| IMEP | indicated mean effective pressure              |
| K    | cavitation number                              |
| KH   | Kelvin-Helmholtz model                         |
| La   | Laplace number                                 |
| LES  | large eddy simulation                          |
| LHF  | lower heating value                            |
| LISA | linearized instability sheet atomization model |
| LTO  | low temperature oxidation                      |
| M    | third body species in chemical reactions       |
| MEF  | maximum entropy formalism                      |
| MW   | molecular weight                               |
| NTC  | negative temperature coefficient               |
| Nu   | Nusselt number                                 |

