Fundamentals of aluminium metallurgy
Production, processing and applications

Edited by Roger Lumley
Fundamentals of aluminium metallurgy
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**Contributor contact details**  

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Contributor contact details

(* = main contact)

Editor and chapters 1 and 10
Roger Lumley
Principal Research Scientist
CSIRO Light Metals Flagship
Private Bag 33
Clayton South MDC
Melbourne
Victoria 3169
Australia
E-mail: Roger.Lumley@csiro.au

Chapter 3
Halvor Kvande
Professor of Chemical Engineering
Department of Chemical Engineering
Qatar University
P.O. Box 2713
Doha
Qatar
E-mail: halvorkvande@qu.edu.qa;
halvor.kvande@hydro.com

Chapter 2
James Metson
Department of Chemistry and Light Metals Research Centre
The University of Auckland
Private Bag 92019
Auckland, 1142
New Zealand
E-mail: j.metson@auckland.ac.nz

Chapter 4
Graeme Wallace
Trading Manager
Sims Aluminium Pty Limited
P.O. Box 602 Sunshine VIC 3187
Australia
E-mail: graeme.wallace@simsmm.com
Chapter 5
John F. Grandfield
Grandfield Technology Pty Ltd
37 Mattingley Cr
Brunswick West
Victoria 3055
Australia
E-mail: grandfieldtechnology@gmail.com

M.A. Easton
CAST Cooperative Research Centre
Monash University
Clayton
Victoria 3069
Australia
E-mail: mark.easton@eng.monash.edu.au

Chapter 6
Somboon Otarawanna
Researcher/National Metal and Materials Technology Center (MTEC)
Thailand

Arne K Dahle*
Professor of Materials Engineering
The University of Queensland
Australia
E-mail: A.Dahle@uq.edu.au

Chapter 7
Geoffrey K. Sigworth
GKS Engineering Services
1710 Douglas Ave
Dunedin
FL 34698
USA
E-mail: gksigworth@gmail.com

Chapter 8
J.A. Taylor*
D.H. StJohn
CAST Cooperative Research Centre
The University of Queensland
St Lucia
Queensland 4072
Australia
E-mail: john.taylor@uq.edu.au; d.stjohn@uq.edu.au

W.J. Poole* and J.D. Embury
Department of Materials Engineering
The University of British Columbia
309-6350 Stores Road
Vancouver
BC, V6T 1Z4
Canada
E-mail: warren.poole@ubc.ca

D.J. Lloyd
Novelis Global Technology Centre
P.O. Box 8400
945 Princess Street
Kingston
Ontario
K7L 5L9
Canada

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Contributor contact details xv

Chapter 12
G. Sha*, R.K.W. Marceau and S.P. Ringer
Australian Key Centre for Microscopy and Microanalysis
Madsen Building F09
The University of Sydney
New South Wales 2006
Australia
E-mail: s.ringer@usyd.edu.au; g.sha@usyd.edu.au

Chapter 13
I.J. Polmear
Professor Emeritus
Department of Materials Engineering
Monash University
Melbourne 3800
Australia
E-mail: ian.polmear@eng.monash.edu.au

Chapter 14
Alberto Somoza*
Instituto de Física de Materiales Tandil – IFIMAT
Universidad Nacional del Centro de la Provincia de Buenos Aires and Comisión de Investigaciones Científicas de la Provincia de Buenos Aires
Pinto 399
B7000GHG Tandil
Argentina
E-mail: asomoza@exa.unicen.edu.ar

Alfredo Dupasquier
Department of Physics
LNESS
Politecnico di Milano
via Anzani 42
I-22100 Como
Italy

Chapter 15
Christopher R. Hutchinson
Department of Materials Engineering
Monash University
Clayton Campus
Clayton
Victoria 3800
Australia
E-mail: christopher.hutchinson@monash.edu

Chapter 16
Yuri Estrin*
ARC Centre of Excellence for Design in Light Alloys
Department of Materials Engineering
Monash University, Clayton 3800 VIC
Australia
E-mail: yuri.estrin@eng.monash.edu.au

and

CSIRO Division of Process Science and Engineering
Clayton South 3169 VIC
Australia

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Chapter 17
Diana A. Lados
Department of Mechanical Engineering
Integrative Materials Design Center
Worcester Polytechnic Institute
Washburn Building
100 Institute Road
Worcester
Massachusetts 01609
USA
E-mail: lados@wpi.edu

Chapter 18
John F. Knott
School of Metallurgy and Materials
The University of Birmingham
Elms Road
Edgbaston
Birmingham B15 2TT
UK
E-mail: J.F.Knott@bham.ac.uk

Chapter 19
Nick Birbilis*
Monash University
Australia
E-mail: nick.birbilis@eng.monash.edu.au

Chapter 20
Bruce Hinton
Monash University
Australia
E-mail: bruce.hinton@eng.monash.edu.au

Chapter 21
S. Lathabai
Principal Research Scientist
CSIRO Process Science and Engineering
Private Bag 33, Clayton South MDC
Victoria 3169
Australia
E-mail: sri.lathabai@csiro.au

S.H. Huo*, Ma Qian and G.B. Schaffer
The University of Queensland
School of Mechanical and Mining Engineering
CAST CRC
Brisbane
QLD 4072
Australia
E-mail: Shuhai.huo@uq.edu.au

E. Crossin
The University of Queensland
School of Mechanical and Mining Engineering
CAST CRC
Brisbane
QLD 4072
Australia
E-mail: enda.crossin@rmit.edu.au

and
Abstract: This chapter provides the introduction to the book and gives a brief overview of the history and growth of the global aluminium industry up to the present day, including some of the significant achievements, breakthroughs and challenges. It also discusses the future avenues of growth and where the global industry may be headed over the next 20 years.

Key words: aluminium industry, aluminium alloys, primary aluminium, secondary aluminium.

1.1 Aluminium as an engineering material

Aluminium is the third most abundant element in the earth’s crust, and the most abundant metallic element. For the last 50 years, it has been second only to iron in its industrial use. Aluminium does not occur in an elemental state; rather it is always combined in a chemical compound. Its existence was not recognized until 1808, when an impure form was identified by Sir Humphry Davy in Britain. In 1825, Hans Christian Oersted of Denmark produced minute quantities of the metal, and two years later Freidrich Wöhler of Germany described a process for producing aluminium as a powder by reacting potassium with anhydrous aluminium chloride. In 1845, he determined its specific gravity thereby establishing it as a low-density metal. The first commercial process for producing aluminium was developed by Henri Sainte-Claire Deville in 1854, using an improved version of Wöhler’s process. The metal was, however, still very expensive, and during the next 30–40 years numerous attempts were made to develop more economic processes whereby costs could be reduced. Developments during this period are described in an interesting book by Aldophe Minet (1902, 1905) published first in German in 1902 and then English in 1905.

The development of the present electrolytic process occurred almost simultaneously in 1886 by Charles Martin Hall in the United States and Paul L.T Héroult of France (i.e. the Hall–Héroult process). This represented a major advance, since it opened the way for the economical production of aluminium, which began in about 1890. One essential stage in the process was the extraction of alumina (Al₂O₃) from the ore bauxite, and an efficient method to do this was developed by Karl Joseph Bayer in 1888. A further essential factor was the availability since the early 1870s of generators capable of supplying electricity on the large scales required for electrolysis. To this day, the Bayer and the Hall–Héroult processes have remained the most economical methods for the production of commercial quantities of aluminium, and are the mainstay of the primary aluminium industry.