

MATERIALS TECHNOLOGY

PUBLICATIONS

71 Chalk Hill, Watford, Herts WD19 4DA, England, UK. Tel: +44 1923 237910 Fax: +44 1923 211510 Internet: www.mat-tech.co.uk

A new Market Report on the Fuel Cells Industry...

THE FUEL CELLS INDUSTRY WORLDWIDE: A MARKET / TECHNOLOGY REPORT

By Dr Alan Comyns

ISBN 1 871677 47 5 (Published February 2004)

- **Comprehensive market/technology report appraises the current status and future prospects for the fuel cells industry worldwide**
- **Worldwide fuel cells business - describes the commercial and R&D activities of over 500 companies and research centres globally, with full contact details:**
 - fuel cell manufacturers/suppliers
 - fuel cell components manufacturers/suppliers
 - manufacturers/suppliers of materials used in fuel cells
 - research organisations carrying out R&D work
- **Describes the seven types of fuel cell, listing their manufacturers and developers, and discussing their current technical and commercial status**
- **Compares the advantages and disadvantages of all fuels being commercially developed**
- **Outlines and reviews the fuel processors being developed**
- **Discusses the structure of the fuel cell industry worldwide, with information on recent mergers and acquisitions**
- **Assesses technical developments and their potential implications for the industry over the next decade**
- **Reviews and compares business forecasts**
- **Over 225 A4 pages long**

Available now: The Fuel Cells Industry Worldwide: A Market / Technology Report, analyses the current status and potential markets for all fuel cell types, discusses the present barriers to commercialisation and assesses the potential implication of technical developments – such as advances in materials technology - on future markets.

Also outlined in the report are the end user sectors for fuel cells – including automotive, portable power supply (such as laptops and mobile phones), stationary units (such as those for domestic use and neighbourhood power stations), and military applications. The report highlights the state of fuel cell commercialisation for each application, and discusses key growth areas.

Key report findings include:

- The polymer electrolyte membrane fuel cell (PEMFC) is by far the most popular fuel cell type under development at present, with about 80 companies worldwide developing PEMFCs, mainly for stationary and automotive applications. The US market for PEMFC stacks is estimated to be about \$150 million currently, and this will rise to nearly \$500 million by 2009;
- Molten carbonate fuel cell (MCFC) costs are currently about \$5000/kW, with a target for mass commercial applications set at \$1000/kW. Current thinking is that MCFCs of up to 500 kW will be uneconomic, but cells of between a few MWs and a few hundreds of MWs are likely to be commercialised in 5-8 years;
- The global market for SOFCs is currently estimated at \$123 million, of which, the North American market is thought to be about \$67 million. Applications for SOFCs, which include on-site power systems, transportation and utility supplies, are predicted to total \$360 million worldwide by 2005;
- At an estimated \$4500/kW, phosphoric acid fuel cells (PAFCs) are too expensive for everyday needs, and were not designed for convenient mass production. Furthermore, they require replacement after 5 years;
- Ballard dominates in fuel cells for automobiles, having supply agreement with DaimlerChrysler, Ford, Honda and Nissan. Among the major automobile producers, only Toyota and Honda are producing their own fuel cells. General Motors believes that fuel cell-powered automobiles will be mass-produced by 2010;
- Casio, Hitachi, Motorola, NEC, Smart Fuel Cell and Toshiba are developing methanol-powered DMFCs for laptop computers. Integrated systems are expected to be commercialised by 2005.

Over 225 pages long, the report lists more than 500 fuel cells companies worldwide, providing comprehensive and up-to-date information on the fuel cell systems, components and/or materials that they supply or are currently developing. Research organisations are also listed. Full contact information is provided, including postal address, telephone and fax numbers, website address and the names of key personnel.

A review of recent mergers and takeovers is also provided, outlining the speed with which the sector is developing: over 30 mergers and acquisitions have occurred in the last three years alone.

The report also provides information on key international research programmes funded by government initiatives and commercial consortia.

TABLE OF CONTENTS

- I. Introduction
 - 3.16 Hydrogen storage vessels
- 2. Fuel cells
 - 2.0 Introduction
 - 2.1 Alkaline fuel cells (AFCs)
 - 2.1.1 Technology
 - 2.1.2 Organisations
 - 2.2 Polymer electrolyte membrane fuel cells (PEMFCs)
 - 2.2.1 Technology
 - 2.2.2 Organisations
 - 2.3 Direct methanol fuel cells (DMFCs)
 - 2.3.1 Technology
 - 2.3.2 Organisations
 - 2.4 Phosphoric acid fuel cells (PAFCs)
 - 2.4.1 Technology
 - 2.4.2 Organisations
 - 2.5 Molten carbonate fuel cells (MCFCs)
 - 2.5.1 Technology
 - 2.5.2 Organisations
 - 2.6 Solid oxide fuel cells (SOFCs)
 - 2.6.1 Technology
 - 2.6.2 Organisations
 - 2.7 Metal-air fuel cells
 - 2.7.1 Zinc
 - 2.7.2 Aluminium
 - 2.7.3 Magnesium
 - 2.8 Comparison of fuel cell types
 - 2.9 The future
- 3. Materials and sub-assemblies
 - 3.0 Introduction
 - 3.1 Ion-exchange membranes
 - 3.2 Porous polymers
 - 3.3 Structural plastics
 - 3.4 Composites
 - 3.5 Sealants
 - 3.6 Metals
 - 3.7 SOFC electrolytes
 - 3.8 Other ceramics
 - 3.9 High temperature insulating materials
 - 3.10 Catalysts
 - 3.10.1 Electrocatalysts
 - 3.10.2 Fuel processing catalysts
 - 3.11 Carbons
 - 3.11.1 Graphite
 - 3.11.2 Carbon black
 - 3.11.3 Fibres, sheets
 - 3.11.4 Fullerenes, nanotubes
 - 3.12 Electrodes
 - 3.13 Membrane electrode assemblies (MEAs), bipolar plates, gas diffusion plates, bellows
 - 3.14 Thermal management systems
 - 3.15 Hydrogen storage materials
- 4. Fuels
 - 4.0 Introduction
 - 4.1 Hydrogen
 - 4.2 Gasoline and other hydrocarbons
 - 4.3 Methanol
 - 4.4 Other fuels
 - 4.5 Oxidants
- 5. Fuel processors
 - 5.1 Technology
 - 5.2 Organisations
- 6. Applications
 - 6.1 Introduction
 - 6.2 Static utilities
 - 6.2.1 Households
 - 6.2.2 Neighbourhoods, institutions, factories
 - 6.2.3 Larger communities
 - 6.3 Transportation
 - 6.3.1 Automobiles
 - 6.3.2 Buses
 - 6.3.3 Scooters
 - 6.3.4 Motorcycles
 - 6.3.5 Submarines
 - 6.4 Portable electronics
 - 6.4.1 Portable computers
 - 6.4.2 Mobile telephones and other electrical equipment
 - 6.4.3 Military electronics
- 7. Mergers and acquisitions
- 8. Economics and forecasts
- 9. Barriers to commercialisation
 - 9.1 Capital costs
 - 9.2 Performance
 - 9.3 Fuel supply infrastructure
 - 9.4 Platinum supply
 - 9.5 Legislation
- 10. The global picture
 - 10.1 International comparisons
 - 10.2 International programmes
 - 10.3 National patterns and initiatives
 - 10.4 Consortia
- 11. Bibliography and further sources of information
- 12. Review of current status of fuel cells companies and other organisations

ORDER FORM

(Payment in full must be received before reports are sent. Please tick appropriate boxes)

- Please send me **THE FUEL CELLS INDUSTRY WORLDWIDE: A MARKET / TECHNOLOGY REPORT**
at Euro €1080 or U.S. \$1350 or £740 (tick one box)
- Please send me ____ extra copies of **THE FUEL CELLS INDUSTRY WORLDWIDE: A MARKET / TECHNOLOGY REPORT**
at the reduced price of Euro €220 or U.S. \$275 or £150 each
(NOTE: One copy of the report must be purchased at the full price to be entitled to the extra copy price)
- Please send the report as printed paper version CD-ROM (saved as a Microsoft Word document) (tick one or both)
- A cheque is enclosed (payable to "Materials Technology Publications")
- Please send me a pro-forma invoice (NOTE: This includes details of how to pay by bank transfer)
- Please debit my credit card: Visa MasterCard American Express

Card Number _____ Expiry Date _____

Cardholder _____ Signature _____

(Credit card payments will be charged at the £ Pounds Sterling price)

SIGNATURE _____ NAME _____ DATE _____

COMPANY _____

ADDRESS _____

_____ POST CODE / ZIP _____ COUNTRY _____

TELEPHONE NUMBER _____ FAX NUMBER _____

E-MAIL ADDRESS _____

Your VAT / TVA / UST Number (EU countries only) _____

(Our VAT Number GB 490 2566 39)

Please return this form by fax or post to:

MATERIALS TECHNOLOGY PUBLICATIONS

71 CHALK HILL

WATFORD WD19 4DA

ENGLAND, UK

TEL: +44 1923 237910

FAX: +44 1923 211510

INTERNET: www.mat-tech.co.uk

Who should read this report?

- ◆ **Fuel cell manufacturers**, needing to assess the activities and strengths of their competitors
- ◆ **Fuel cell materials and component suppliers**, seeking customers and assessing the potential for new products
- ◆ **Manufacturers/processors/suppliers of fuels**, such as hydrogen and methanol
- ◆ **Market analysts**, researching the current and potential markets for fuel cells
- ◆ **Technology transfer consultants**, seeking new business opportunities
- ◆ **Battery manufacturers**, needing to assess this new competition
- ◆ **Utility companies**, considering trial projects
- ◆ **Oil companies**, planning their long-term positions in the energy market
- ◆ **Electrical and electronic equipment manufacturers**, considering introducing fuel cell-powered versions of their equipment (such as laptops and mobile telephones)
- ◆ **Users of non-interruptible power supplies**, needing to assess current technologies
- ◆ **Process developers**, seeking new projects having high potential, especially in hydrogen production
- ◆ **Government departments**, reviewing the competitive strengths of their respective countries' technologies
- ◆ **University departments**, working in the fuel cell field, needing an up-to-date review of the global commercial scene
- ◆ **Reference librarians**, needing up-to-date information for their users
- ◆ **Venture capitalists**, seeking new investments and amalgamation possibilities
- ◆ **Private investors**, considering investing in fuel cells

ABOUT THE AUTHOR / MATERIALS TECHNOLOGY PUBLICATIONS

The author, Dr Alan E Comyns, has had an extensive career in academic, government and industrial research laboratories. He has worked at Harwell Laboratories and British Titan Products in the UK, and in the USA has worked for Westinghouse Electric in Pittsburgh and National Lead in New Jersey. From 1974 to 1988 he was Product Research Manager, later Chief Scientist, at Laporte Industries in Widnes, UK.

He is now an independent consultant and author, specialising in market studies on inorganic chemicals and materials. He is the author of the *Encyclopedic Dictionary of Named Processes in Chemical Technology* (CRC Press, 1999) and the editor of *Fluoride Glasses* (John Wiley, 1989).

Dr Comyns was formerly editor of *Focus on Electronics Chemicals* newsletter (Royal Society of Chemistry) and is currently the editor of *Focus on Catalysts* newsletter (Elsevier). He is a frequent reviewer of books for *Chemistry in Britain* and *Chemistry and Industry*.

Established in 1985, Materials Technology Publications specialises in the publication of market reports and directories within the area of industrial materials. Other titles published by Materials Technology Publications include "European Technical Ceramics Directory", "The Advanced Composites Industry – Global Markets, Technology Trends and Applications 2002-2007", "European and International Refractories Industry: A Market/Technology Report", and "European and International Abrasives Industry: A Market/Technology Report".

Market reports published by Materials Technology Publications examine the worldwide markets for various materials sectors. Each report analyses the current and future prospects for specific industries and provides pertinent statistical data on production, growth rates, imports, exports, etc. Key companies are identified and their performances compared. The impact of advances in production methods and materials technology is also assessed.