ElringKlinger

Components for Electric Energy Storage and Fuel Cell Systems from ElringKlinger

A3PS-Conference
Eco-Mobility 2025 plus
November, 10th 2015, Wien

Dr. Uwe Maier
Head of Fuel Cell Department
Company History

1879  Foundation of Paul Lechler in Stuttgart, Germany (later: Elring GmbH)
1885  Foundation of Richard Klinger in Vienna, Austria
1994  Merger of Elring GmbH and Richard Klinger Automotive to Elring Klinger GmbH
2000  Merger of Elring Klinger GmbH and ZWL Grundbesitz- und Beteiligungs-AG (former Holding Company of Elring Klinger GmbH), renaming as ElringKlinger AG
2008  Acquisition of Sevex AG based in Sevelen, Switzerland
2009  Acquisition of the Turkish automotive supplier Ompaş A.Ş., Bursa
2011  Acquisition of the Static Flat Gaskets business of the Freudenberg Group (Germany, France, Italy)
2011  Takeover of a 66.7% interest in the Swiss Hug Group based in Elsau, Switzerland (since 2013: 93.67%)
2014  Acquisition of 75.0% of the shares in the New Enerday GmbH, Neubrandenburg
2015  Acquisition of the U.S. automotive supplier M&W Manufacturing Co., Michigan
Shareholder structure*

- Family W. H. Lechler and estate of Klaus Lechler: 52.1%
- Institutional investors: 40.3%
- Private investors: 7.6%

* Based on information available to the company as of December 31, 2014
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Worldwide

Germany
Dettingen/Erms
Langenzenn
Runkel
Geretsried-Gelting
Thale
Lenningen
Bietigheim-Bissingen
Heidenheim
Mönchengladbach
Idstein
Rottenburg/Neckar
Magdeburg
Neubrandenburg

Europe
Redcar, Great Britain
Gateshead, Great Britain
Nantiat, France
Poissy, France
Chamborêt, France
Sevelen, Switzerland
Elsau, Switzerland
Enschede, Netherlands
Reus, Spain
Settimo Torinese, Italy
Milan, Italy
Kecskeméti-Kádafalva, Hungary
Timisoara, Romania
Bursa, Turkey

North America
Leamington, Canada
Plymouth, USA
Buford, USA
Austin, USA
Warren, USA
Toluca, Mexico

South America
Piracicaba, Brazil

Africa
Johannesburg, South Africa

Asia
Ranjangaon, India
Changchun, PR China
Suzhou, PR China
Qingdao, PR China
Gumi, South Korea
Seoul, South Korea
Tokyo, Japan
Saitama, Japan
Karawang, Indonesia
Bangkok, Thailand

11/10/2015
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**Employees ElringKlinger Group worldwide**

as of December 31, 2014 (py)

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<tr>
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<th>Group</th>
<th>Germany</th>
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<tr>
<td></td>
<td>7,255 (6,716)</td>
<td>3,342 (3,055)</td>
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<td>+ 8.02%</td>
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International subsidiaries: 3,913 (3,661)

Domestic subsidiaries: 854 (754)

AG: 2,488 (2,301)
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Group Sales

EUR million

2008: 658
2009: 579
2010: 796
2011: 1,033
2012: 1,127
2013: 1,150
2014: 1,326
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Divisions

Cylinder-head gaskets
Specialty gaskets
Plastic modules
Lightweight plastic components
Shielding systems
Aftermarket

E-Mobility
Fuel cells
Exhaust gas purification
Engineered plastics
Engine testing services
Tooling technology

Battery and fuel cells
Expertise at a glance
Role of ElringKlinger in these business areas

As a global development partner and original equipment manufacturer we supply a large section of the international automotive industry. In the field of alternative drive technology, we develop innovative components to start-of-production level.
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At the heart of the key issues of the automotive industry

Lowering emissions

Weight reduction

Optimizing the combustion engine “Downsizing”

Alternative drivetrain technologies
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Fuel cell and battery related production processes

Sheet metal forming  
Injection molding  
In house tooling

Joining technologies  
Coating technologies  
Sheet metal stacking
Components for Electric Energy Storage
Li-Ion battery product and technology range

- Battery modules
- Cell contacting system
- Pressure equalizing element
- Module connectors
- Automotive
  - BEV
  - HEV
  - PHEV
  - Truck application
- Non-Automotive
  - Fork lifts
  - eScooters
  - Marine applications
  - Cleaning machines
  - etc.
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Cell contacting system

- **Requirements**
  - Simple module assembly
  - Integration of cell connectors
  - Integration of signal carrier
  - Integration of sensors for the module control
  - Interface to battery management
  - Directed degassing out of the battery housing

- **Solution**
  - Cell connecting system in plastic frame with integrated voltage and temperature sensors
  - Non-conductive elastomer gasket assembled to the cell contacting system
Pressure equalizing element

- **Requirements**
  - Controlled pressure equalization at atmosphere changes
  - Integrated burst function for degassing

- **Solution**
  - Adjustment of air conductance by the porosity of the PTFE-membrane (developed and produced at an ElringKlinger subsidiary)
  - Precise adjustment of the burst pressure
Battery housing

- Requirements
  - Crash resistance
  - EMC shielding
  - Low weight
  - Integration of functionality
  - Simple assembly

- Solution
  - Utilization of application-specific plastic materials
  - Improvement of weight and stability by forming, by ribs, by numeric optimization of the structure etc.
  - Integration of gaskets, connections, wire guidance etc.
Li-Ion Battery Module

- One module design for a variety of applications
- Optimization of cost, space and weight
- Certification (UN Test/62133) or according to Customer Requirements
Production facilities

- Prototype shop
  - Flexible production of cell contacting samples
  - Production of busbars and cell connectors
  - Production of prototype pressure equalizing element

- Flexible assembly line
  - Manual assembly of cell connectors to the frame
  - Automated ultrasonic welding and sealing
  - EoL-Test-Facilities

- Fully automated production line
  - Automatic stamping-bending machine
  - Automated assembly
  - Joining processes (welding, soldering)
  - EoL test facilities
Fuel Cell Systems and Components for Fuel Cell Systems
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**Fuel cell product and technology range**

- Stack components: Sheet metal bipolar plates, stack end modules, housing/thermal shielding for PEMFC and SOFC
- 1-50kW PEMFC stacks for forklifts, range extenders and other industrial applications
- 0,2-5kW SOFC stacks for power generators and CHP
- 0,2-0,8kW SOFC power generators
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**PEMFC module suitable for mass production**

**Power output** scalable from 1 to 50kW

**One footprint for a variety of applications**

**Focus on manufacturability and cost**

**Integrated functions:**

**Sensors**
- Pressure and temperature, anode and cathode

**Actuators**
- Pressure regulation, anode inlet
- Purge-valve, anode outlet
- Drainage-valve and valves for cathode and anode

**Passive components**
- Droplet separator
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Outstanding performance data

Lifetime test ongoing, currently more than 6500 hrs

Power density (2,5 bar\textsubscript{a}, 380 A @ $U_c=0.6$ V):

- 7,3 kW/l (CCM area $\rightarrow$ low cost)
- 4,6 kW/l (cell block)
- 3,6 kW/l (stack module)
- Dry operation 1,5 A/cm\textsuperscript{2} @ 0,66V

e.g. stack NM 5- 48 cells
- 12 kW @ 2,5 bar\textsubscript{a}
- 7,5 kW @ 1,2 bar\textsubscript{a}

L /W/H (mm): 243/161/73

11/10/2015 Battery and fuel cells
Focus on mass production and early scales
Use of commercially available components
Stacks are commercially available
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SOFC module suitable for mass production

Power output scalable from 0.2 to 5kW

One footprint for a variety of applications

Focus on mass production requirements

Integrated functions:

Sensors

- Temperature

Passive components

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- Rei
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Outstanding performance data

Lifetime test over more than 9000 hrs @ 0,3A/cm² constant.

Power loss less than 0,6% per 1000h

OCV loss less than 3% after 150 full thermal cycles

Power output @ 775 °C; 0,8 V

- 0,5 W/cm² @ 80%FU
- 0,6 W/cm² @ 65%FU
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**Production facilities**

SOFC-stack assembly pilot line. In operation since 2007, recently updated

PEMFC-stack assembly line. Going to be in operation in April 2016
Application examples PEMFC and SOFC
Summary and perspective
Technical maturity – Summary

- All battery and fuel cell products are designed for use in a variety of applications and therefore for early scale effects
- All battery-, PEFC- and SOFC- components and products are technically ready for mass production
- Business models work out in some niches
- Lack of scale effects and minor technical issues prevent marketable cost and therefore mass market
Summary – It‘s all about CO$_2$-reduction

... but why don‘t we see zero emission technology already today at least in niches?
Summary

What is still needed for a successful market introduction?

- Supportive legislation (Emission regulations,...)
- Bonus and/or penalties for zero emission/non zero emission technology

→ Industry and politics will have to move in the same direction for a successful market entry of zero emission technology
→ Joint strategy and clear roadmap for implementation of zero emission technology needed
Experience mobility – Drive the future.

Thank you for your attention.