Plansee metallic SOFC stack components

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PLANSEE facts & figures and its mission for the emerging SOFC market

Plansee Group is a private, family owned company
- Worldwide leading company in powder metallurgical materials and components
- 1.5Bn € sales
- 50 manufacturing sites worldwide
- 8,000 employees
- Competence in mass production of materials and components for automotive, electronic and lighting industries

Plansee contributes to the SOFC market by means of
- Development and manufacturing of high performance, powder metallurgical stack components
- Competitive stack performance through designed alloys based on powder metallurgy
- Cost effective production by means of net shape technologies and mass production competences

First component supplier to enter industrial scale production
SOFC applications served by PLANSEE material & components

Stationary SOFC – applications
(Basic module in robust design)

1st industrial scale markets by 2010

- Residential 1-5 KW
- Small Business 10-50 KW
- Industrial 100 KW to 2 MW

Cogeneration of heat and power
Decentralized grid
Decentralized grid

Mobile SOFC – applications
(Basic module in light weight design)

1st industrial scale markets 2013 - 2015

- Micro Fuel cells 50-500 W
- APU pas. cars 2-5 KW
- APU com. vehicles 10 – 50 KW
SOFC relevant materials & components of PLANSEE

- Stationary SOFC- application

- Mobile SOFC- application

- **Component 1**
  High Temperature P/M Interconnectors via Net shape technology and functional coating on cathode side

- **Component 2**
  FeCr – Interconnector cassette via sheet rolling - stamping – welding technology and functional Coating on cathode side

- **Component 3**
  Metal supported Cell consisting of porous FeCr – Substrate and functional Coatings for electrodes and electrolyte
Powder Metallurgy (P/M) as scaleable, cost efficient technology for high performance, metallic SOFC-stack components

### Robust, stationary SOFC applications

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<td>CFY powder</td>
<td>H₂ sintering</td>
<td>ODS ITM powder</td>
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### Lightweight, mobile SOFC applications

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PLANSEE ODS Cr5FeY (CFY) alloy established as technically and economically viable Interconnects for planar, stationary SOFC systems

- Planar SOFC-design has been selected by system companies both for stationary and mobile applications
- Cost effective Powder Metallurgical Net Shape production Technology for ODS Cr5FeY (CFY) Interconnects in industrial scale facility established
- Electrolyte Supported Cells (ESC) with 800 mW/cm² at button sample and >400 mW/cm² in connection with CFY Interconnector in stack running
- Interfaces between ODS Cr5FeY (CFY) Interconnector and ESC-cells solved by means of LSM diffusion barrier coating preventing Cr-poisoning of cathode
- The corrosion resistance of the ODS Cr5FeY (CFY) Interconnector in various relevant atmospheres enables stack operation times of 40,000 hours.
- Generic Stack design and stack technology for CFY Interconnector and high performance ESC cell established

Robust, high performance and long life SOFC stack available via network of Austrian /German / Swiss industries and research organizations.
PLANSEE supplies coated, ready- to- use metallic SOFC-stack components

**TriplexPro™-200** - Three Cathode APS Gun for CFY- Interconnectors

- Atmospheric Plasma Spraying APS
  - dense and porous coating
  - high feed rates
  - high quality
  - high reproducibility

- Performance and value critical functional coatings to be applied via Plasma spraying technologies e.g. LPSS – Thin film technology for dense, thin layers

- Sulzer Metco as exclusive strategic partner of PLANSEE covering state of art-technologies in plasma spraying

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Sound APS perowskite coating to prevent Cr-cathode poisoning effects

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Sulzer Metco
Availability of High performance Electrolyte Supported Cells (ESC) developed by IKTS and industrialized by Kerafol

- 10 Sc1CeSZ based cells show superior electric conductivity
- Power density of > 500 mW/cm² demonstrated in button cell tests
- Power density of > 400 mW/cm² in combination with CFY Interconnects demonstrated in stack

Industrial capacity for ESC - cells available in Germany

Design and manufacturing technology for high performance SOFC- stacks made of CFY Interconnectors and ESC cells available in Germany
Modular, planar CFY- Interconnector SOFC-stack anologes to modular semiconductor architecture

Stationary SOFC – applications (Basic module in robust design)

- 1-5 KW SOFC-stacks serve as generic building blocks for small and large SOFC systems. **These stacks are the (Energy-) Chip technology of the future.**

- Target performance of CFY-Interconnector stack fullfills requirements of stationary and robust mobile / portable applications
  - < 5 kg/KW; ca. 1 KW/ Liter
  - > 0,5 W/cm² power density
  - > 80% Fuel utilization
  - < 0,5%/1000 h degradation
  - Fuel flexible (diesel, propane, ethanol, biogas, natural gas)
SOFC - stack architecture is significantly reflected in the PLANSEE CFY-Interconnector design.

- CFY-Interconnectors are designed to cost, to processing and to function.
- Target SOFC - stack performance can be achieved by innovative CFY-Interconnector designs.
- SOFC stack robustness and long life capability are inherent to the designed and optimized material composition.

Source: IKTS
CFY- Interconnector Stack is the first „Energy“- Chip technology of the future

Solution of Plansee:

- Competitive (Energy-Chip) SOFC-stack performance through designed alloys and customer specific component geometries based on powder metallurgy
- Cost effective production by means of net shape technologies and mass production competences

„Ready - to - stack“ metallic CFY- Interconnectors made by PLANSEE as performance enabling technology for the „Energy“- chips of the future