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Plansee metallic SOFC stack components

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A Step ahead in Technology.

PLANSEE 

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**

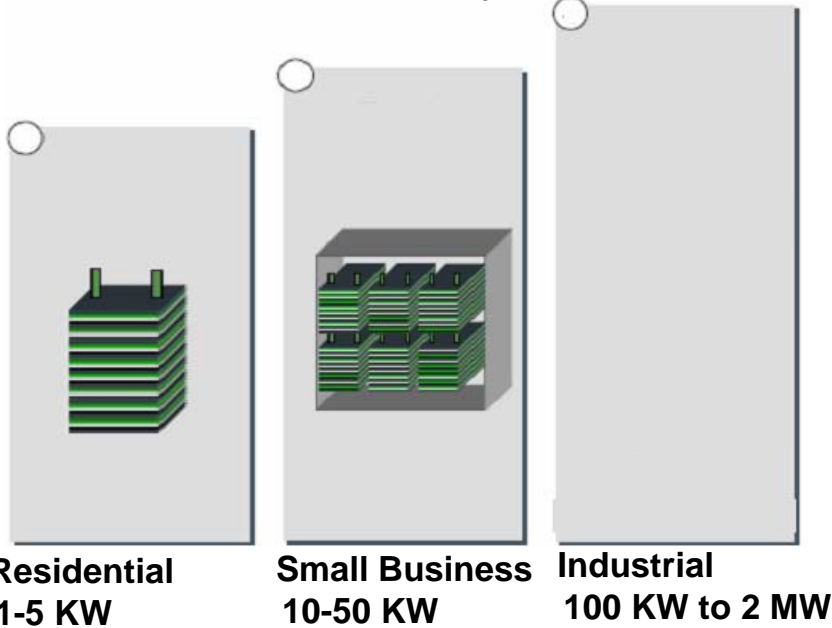
- Development and manufacturing of high performance, powder metallurgical stack components
- Competitive stack performance through designed alloys based on powder metallurgy
- Cost effective production by means of net shape technologies and mass production competences

▶ **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



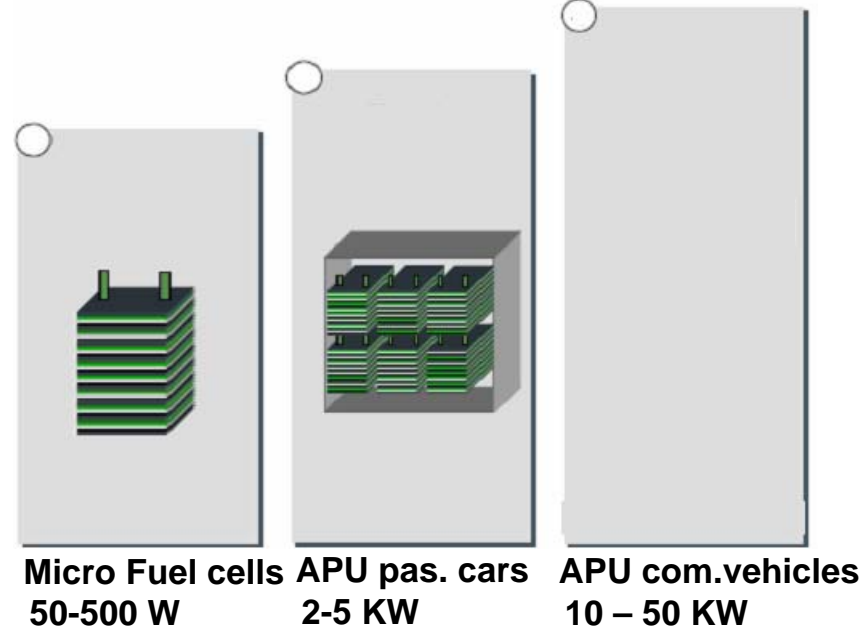
Cogeneration of heat and power

Decentralized grid

Decentralized grid

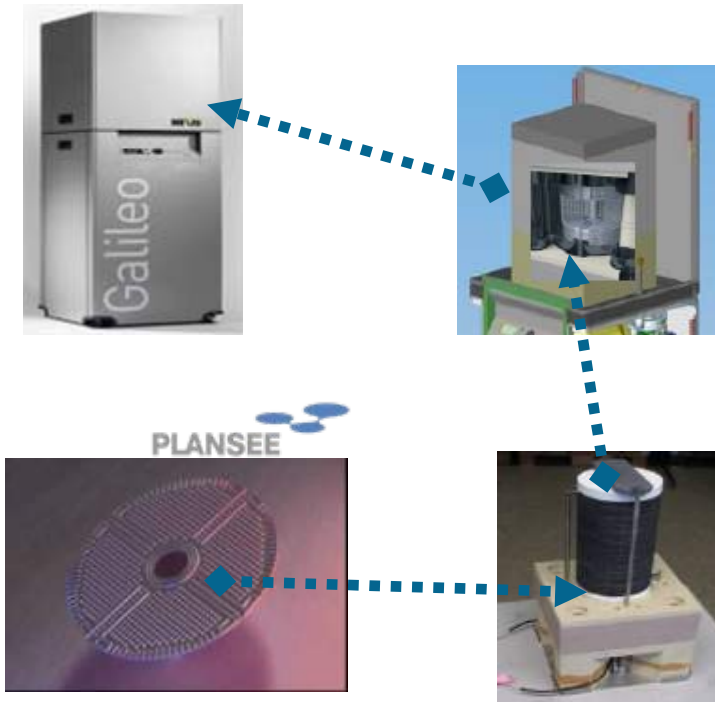
Mobile SOFC – applications
(Basic module in light weight design)

1st industrial scale markets 2013 - 2015



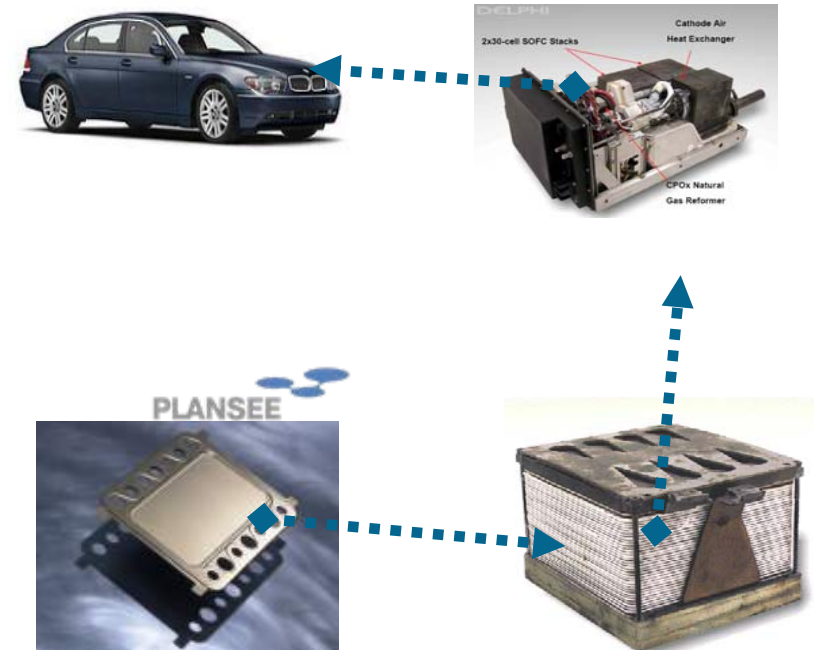
SOFC relevant materials & components of PLANSEE

- Stationary SOFC- application



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

- Mobile SOFC- application

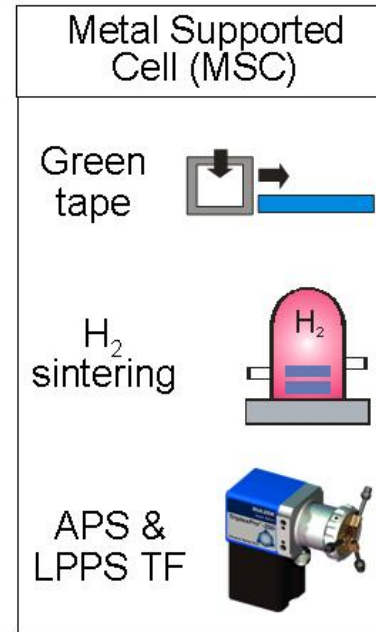
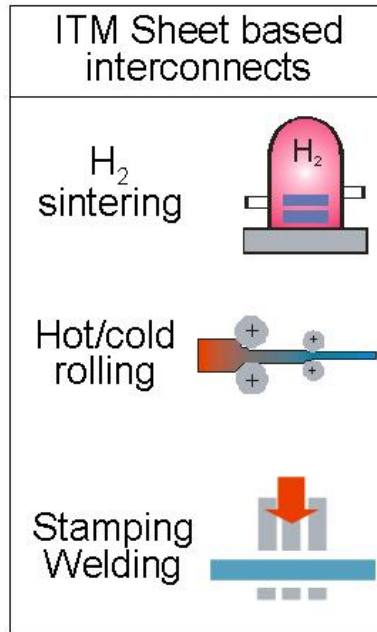
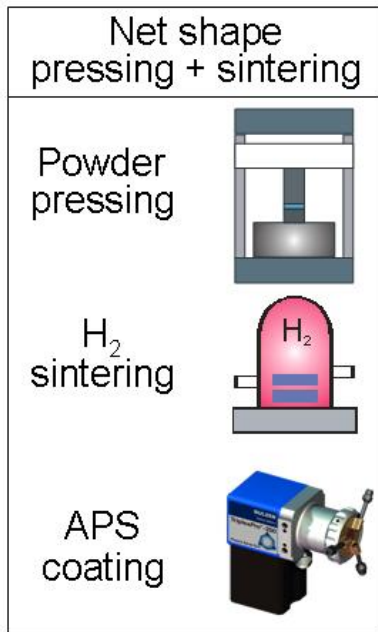


- Component 2**
FeCr – Interconnector cassette via sheet rolling - stamping – welding technology and functional Coating on cathode side
 - Component 3**
Metal supported Cell consisting of porous FeCr – Substrate and functional Coatings for electrodes and electrolyte

Powder Metallurgy (P/M) as scaleable, cost efficient technology for high performance, metallic SOFC- stack components

Robust, stationary SOFC applications

Lightweight, mobile SOFC applications



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

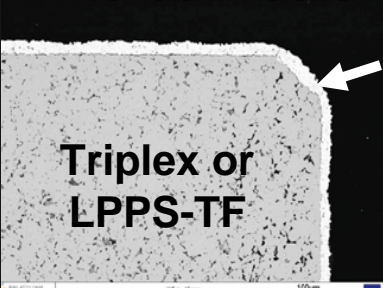
Atmospheric Plasma Spraying APS

- dense and porous coating
- high feed rates
- high quality
- high reproducibility



- Sound APS perovskite coating to prevent Cr-cathode poisoning effects
- Performance and value critical functional coatings to be applied via Plasma spraying technologies e.g. LPPS – Thin film technology for dense, thin layers
- Sulzer Metco as exclusive strategic partner of PLANSEE covering state of art-technologies in plasma spraying

Interconnects IC



ESM Mag = 50X Det = CRSD 100µm

SULZER
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**

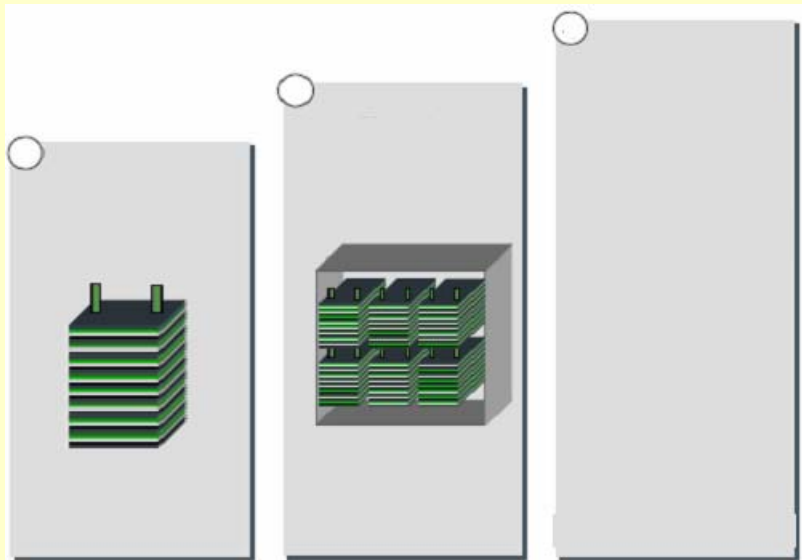


Fraunhofer Institut
Keramische Technologien
und Systeme



Modular, planar CFY- Interconnector SOFC-stack analogues to modular semiconductor architecture

Stationary SOFC – applications
(Basic module in robust design)



**Residential
& Small APU
1-5 KW**

**Small Business
& Large APU
10-50 KW**

**Industrial &
portable Systems
100 KW to 2 MW**

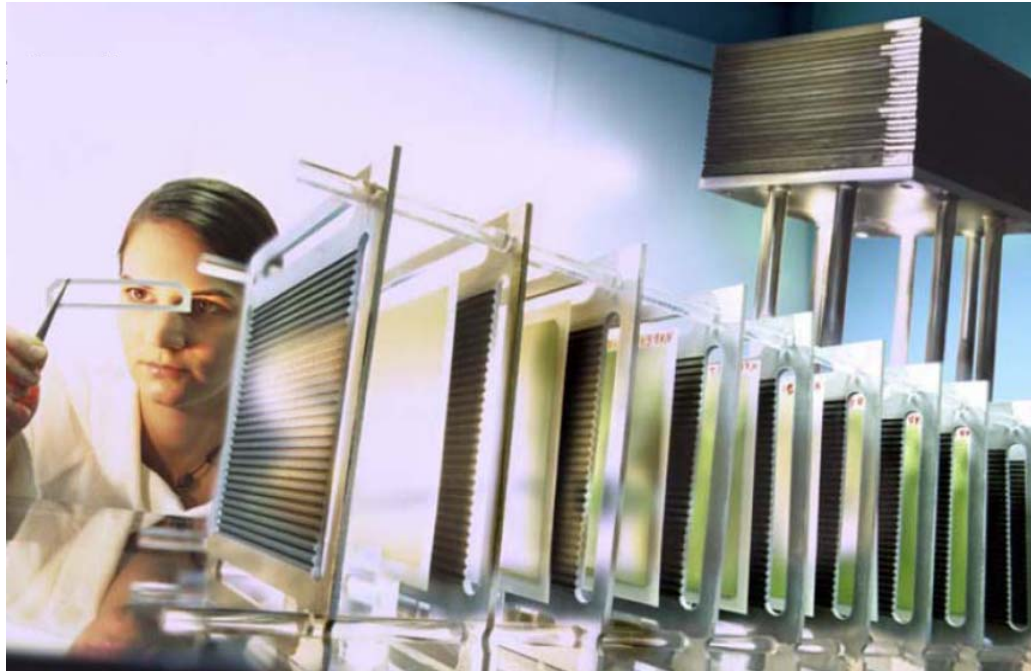
Cogeneration of
heat and power

Decentralized
grid

Decentralized
grid

- 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 fulfills 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.



Source: IKTS

- 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

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

