



Development of Solid Oxide Fuel Cells and Short Stacks for Mobile Application

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Outline

- **Motivation for this Work**
- **Experiments**
- **Results of the Redox and Thermal Cycle Experiments
and of Microstructure Analysis of Cells**
- **Results of 4-Cell Short Stack**
- **Conclusions**
- **Future Work**



Motivation for this Work

Requirements for a SOFC APU Stack for Mobile Application :

- Stacks in the Power Range up to 5 kW
- Light-weight and Compact :
< 4 kg/kW, < 1 L/kW
- Durability > 10.000 h
- About 5000 fast Thermal Cycles
- Frequent Interruption of Fuel Gas :
Stable Redox Behaviour

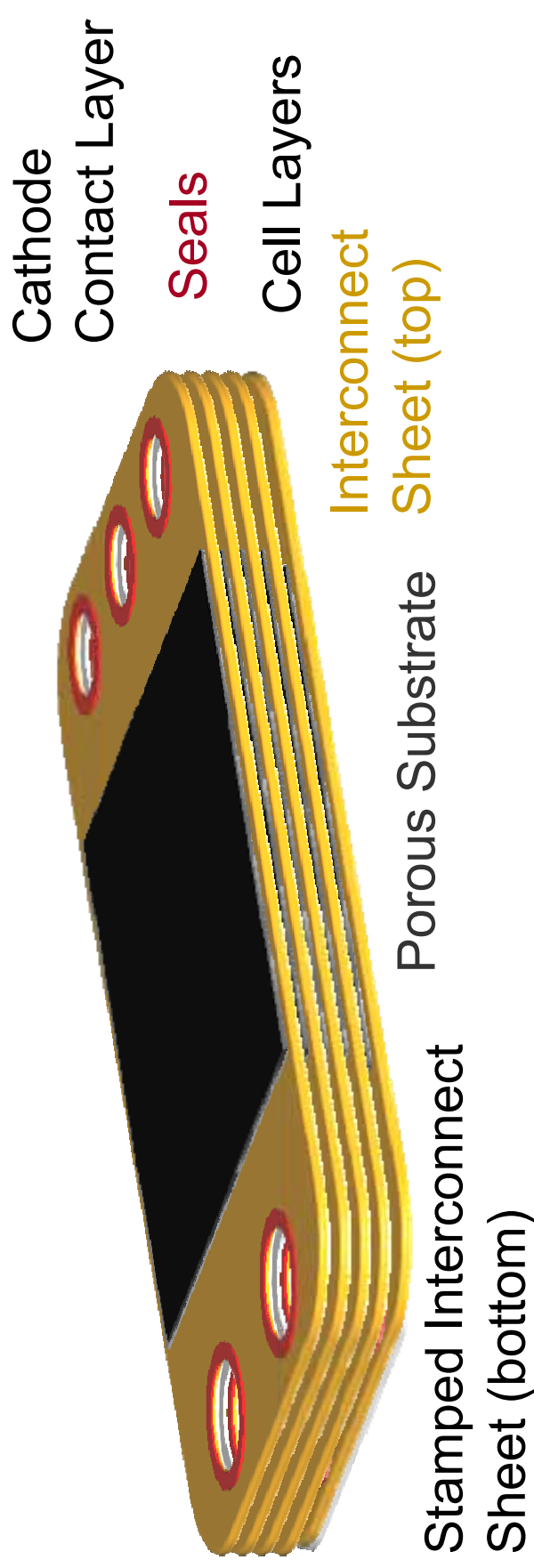


Courtesy : BMW

DLR, Institute of Technical Thermodynamics

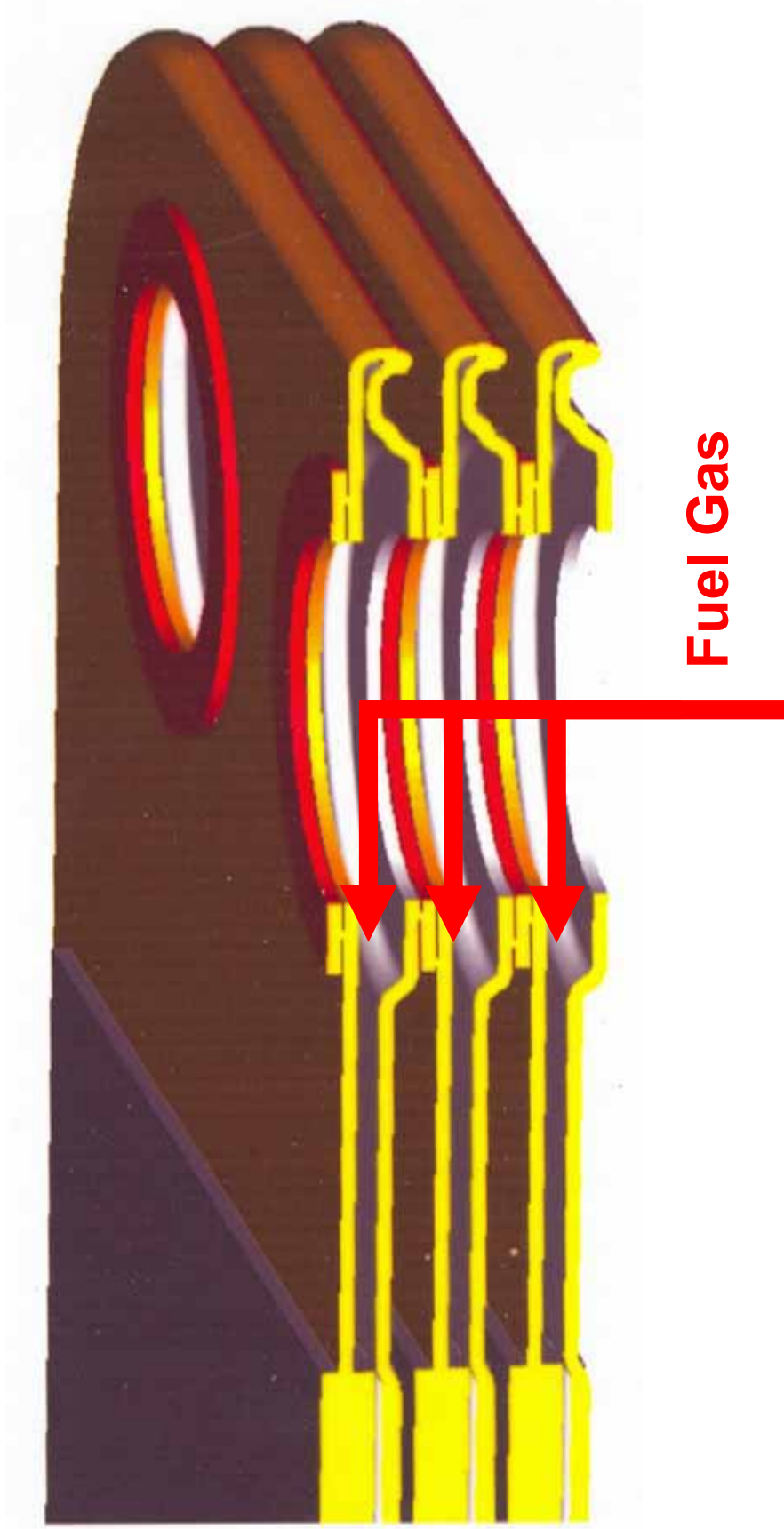


DLR Plasma Spray SOFC Concept (Mobile Application)





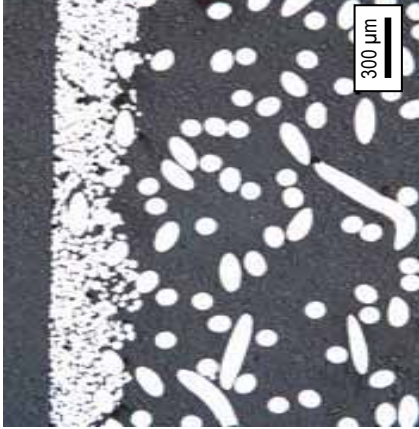
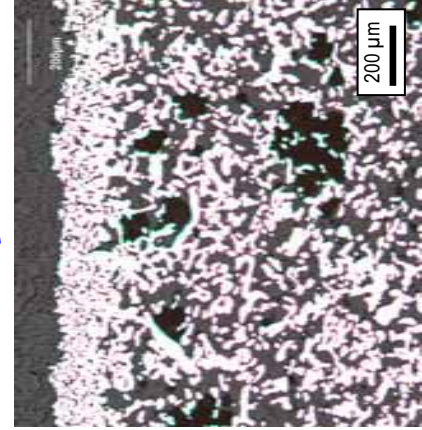
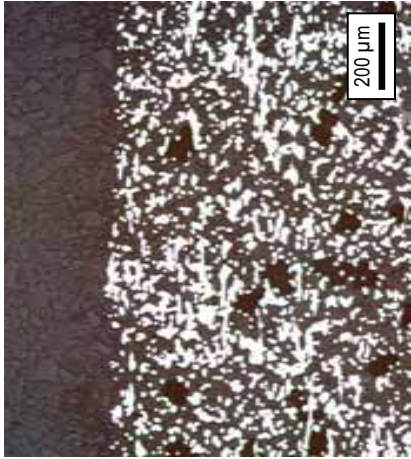
Fuel Gas Flow in the SOFC Cassette Stack





Porous Metallic Substrates Used for the plasma spray SOFC Concept

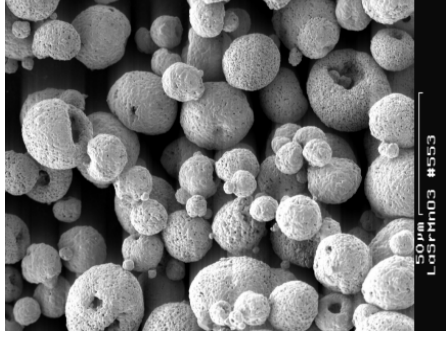
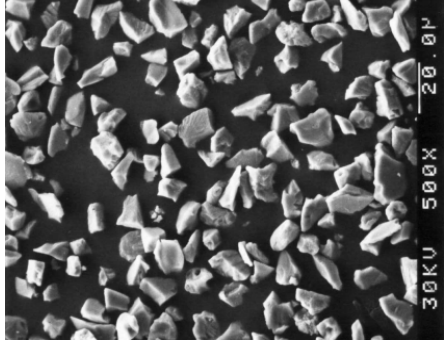
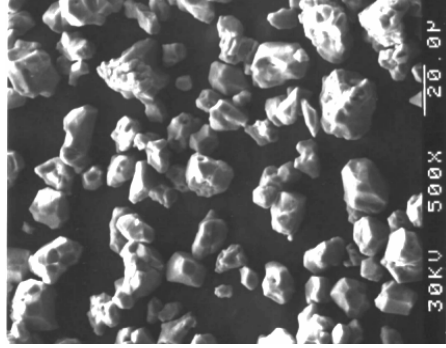
Substrate	Felt	Foam	Knitted Wire Structure	Porous Sintered Plate
Material	Ni	Fe-22Cr-5Al-0,1Y	Fe-22Cr-0,5Mn „CroFer22APU“	Fe-26Cr-(Mo,Ti,Mn,Y ₂ O ₃)
Porosity	~ 85	~ 80	~ 90	~ 50
Supplier	Bekaert, Belgium	Technetics, USA	Rhodium, Germany	Plansee AG, Austria





Powders Used for the Spraying of the Cells

Powder	NiO	ZrO ₂ - 7 mol %Y ₂ O ₃	ZrO ₂ - 10 mol%Sc ₂ O ₃	(La _{0.8} Sr _{0.2}) _{0.98} MnO ₃
Short name	NiO	YSZ	ScSZ	LSM
Morphology	sintered, crushed	sintered, crushed	sintered, crushed	sintered, spherical
Size distribution	10-25 µm	5-25 µm	2-35 µm	20-40 µm
Supplier	Cerac, USA	Medicoat, Switzerland	Kerafol, Germany	EMPA, Switzerland





Vacuum Plasma Spraying Pilot Plant





Plasma Spraying Process of SOFCs





Examples of plasma sprayed SOFCs

Cells (125 cm²) on Metall Sheet Cassettes

Redox- and Thermo Cycle : Short Stack Testing

Button Cells (12 cm²) on Porous Metallic Substrate

