Working Group Modelling and Simulation

***staff*:**	**5 researchers**	
***hardware*:**	**Linux-Workstation's** (8-320 GB-RAM, 8-32 Core CPU), **Win64 Workstation's** (8-32 GB, 2-6 Core CPU)	
***software*:**	**Multiphysics FEM**:	ANSYS, COMSOL, FlexPDE, DiffPack
	CFD:	Fluent, (ANSYS CFX, CosmosFloWorks)
	System simulation:	Matlab/Simulink, SimulationX
	misc.:	Mathematica, C++
***methods*:**	**Multiphysics-FEM**, **Homogenisation** of heterogeneous struktures, **CFD**, **system simulation**	
***topics*:**	**fuel-cell system/ components**	
	thermal design of ceramic components	
	thermo-mechanical analysis of ceramic components	
	multiphysics ...	

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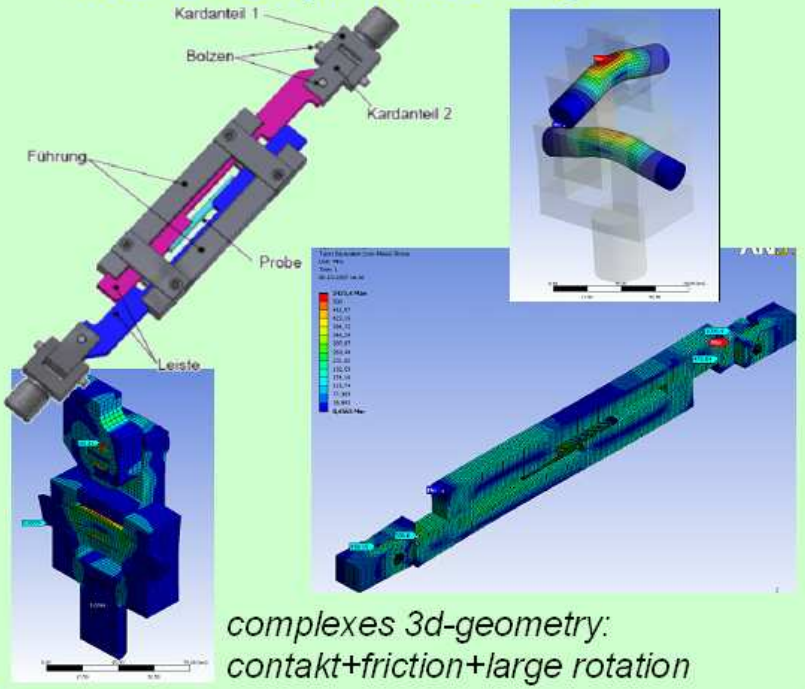
Thermo-mechanical design of (ceramic) components

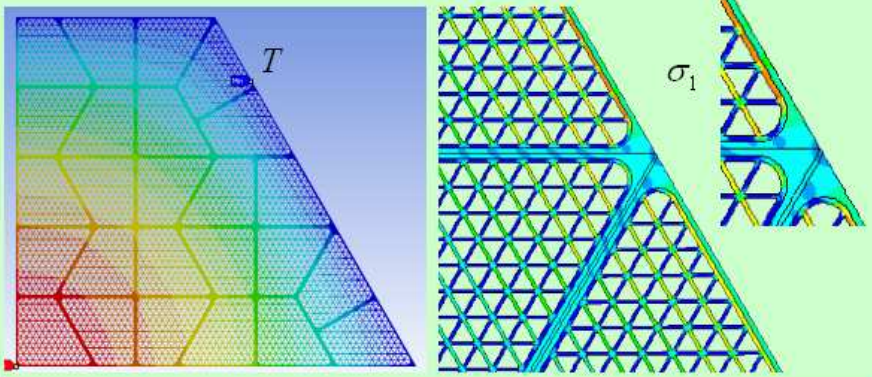
shear-test sample holder design

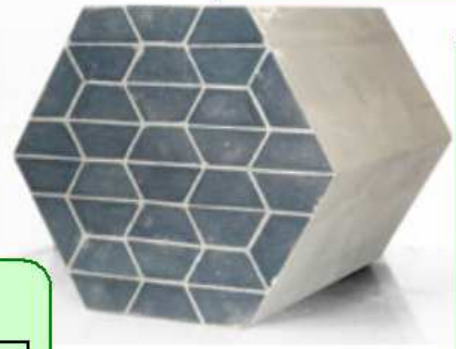


complexes 3d-geometry:
contakt+friction+large rotation

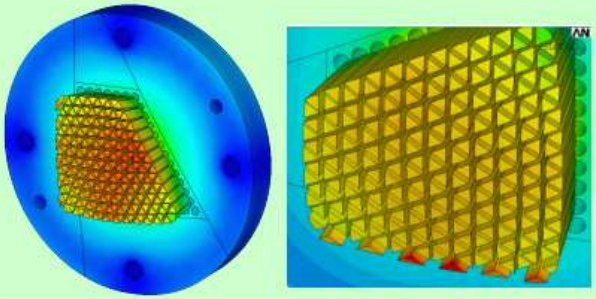
thermo-mechanical analysis of DieselParticulateFilter

thermo-mechanics

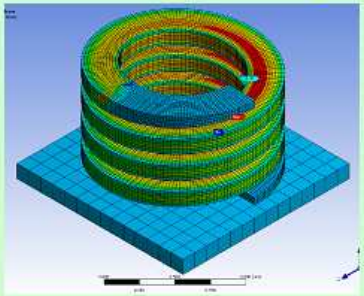


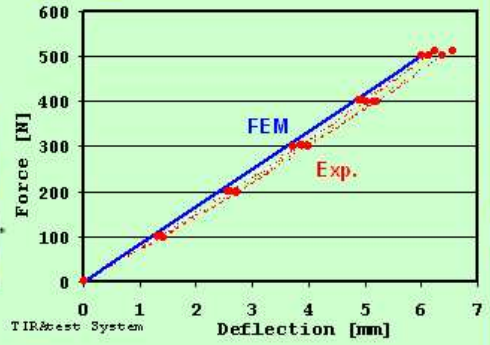


deformation of extrusion nozzle

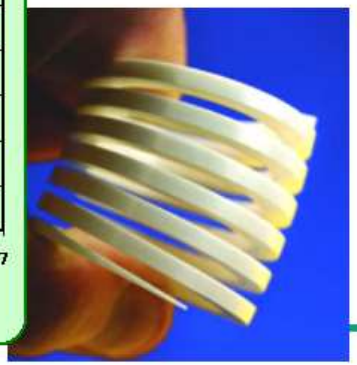


dimensioning of ceramic springs





model based design,
statist. failure analysis



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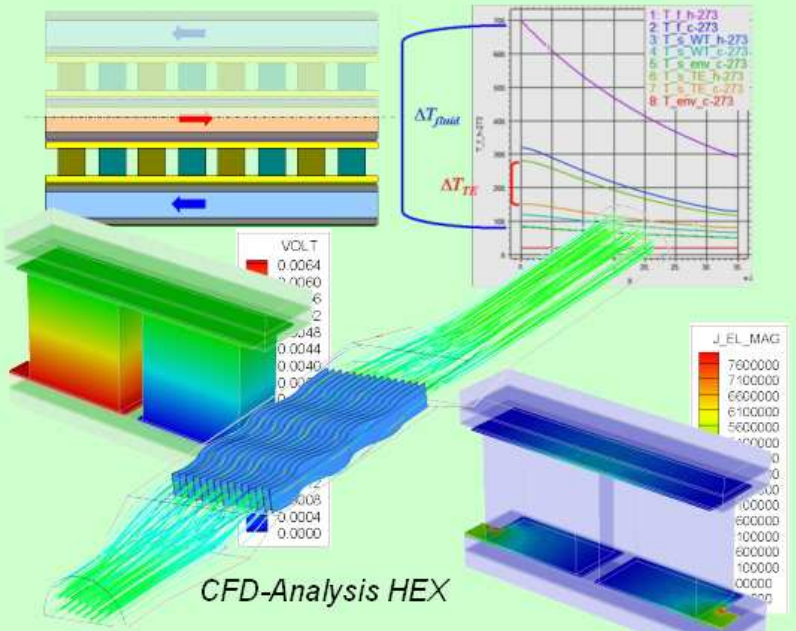
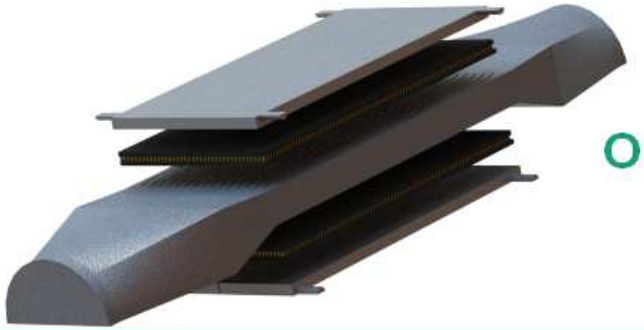
Multiphysics Analysis of components/ structures

repeating unit of thermo-electric modul, integr. Model of thermo-electric generator



CFD-Analysis HEX

userdefin. physics, mode coupling
FE and CFD-Codes:Comsol, FlexPDE, Fluent



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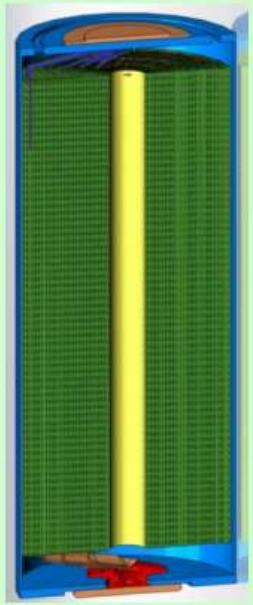
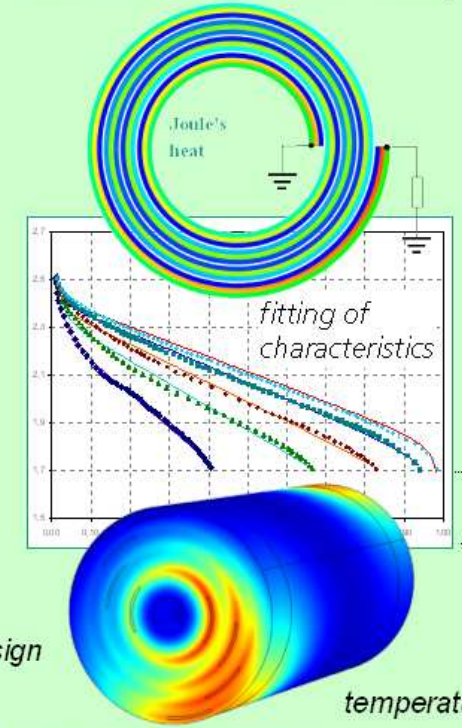
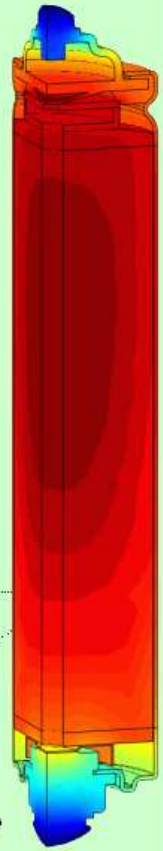
modelling of thermal management in Li-ion-cells

- thermal-electric FE-model (Comsol)
- empirical approach for electro-chemistry
- winding assembly: homogenised composite
  (2 electr. DOF +1 thermal DOF + el.-chem. source term)

detailed model: heat source density







detailed model: cell design

temperature

therm. hot-spots at contact structure

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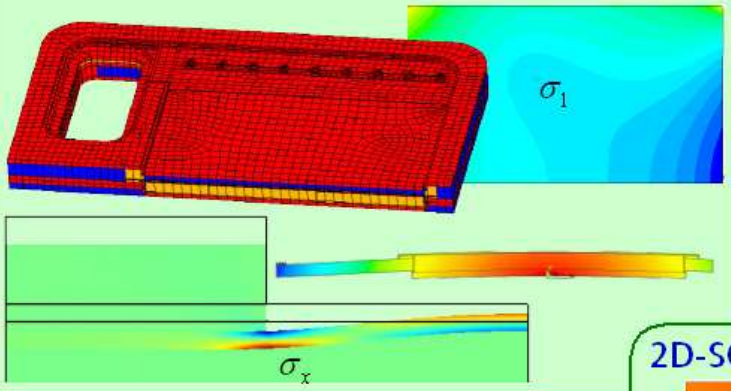
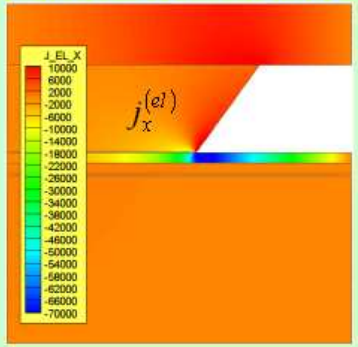
Modelling of fuel-cell-system-components

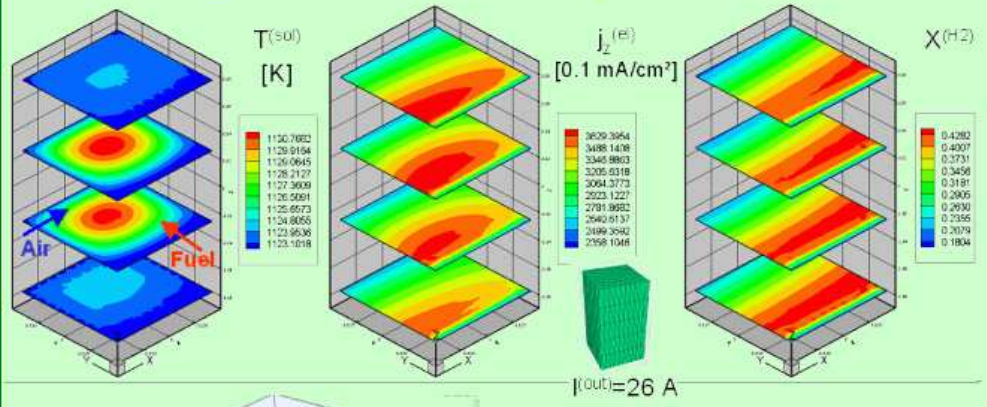
SOFC-thermo-mechanics

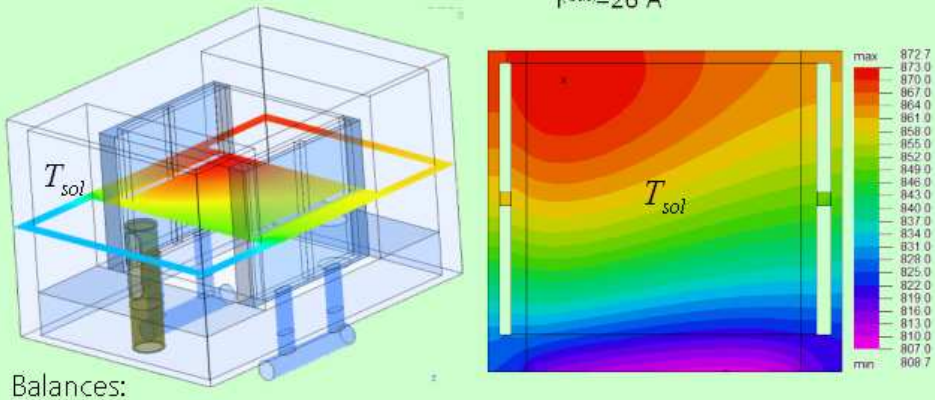


2D-SOFC structure model



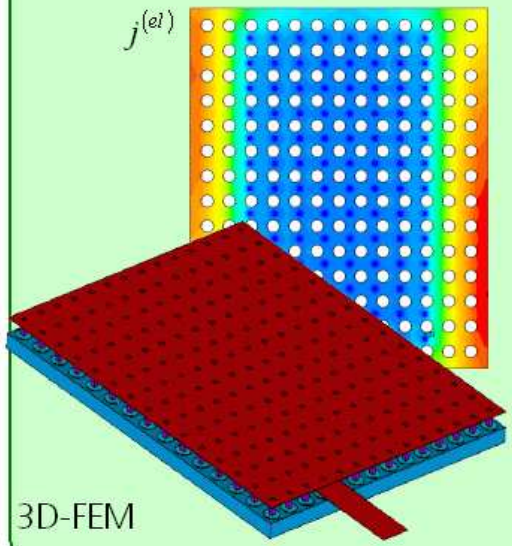
homogenised 3D-SOFC-stack-process-model

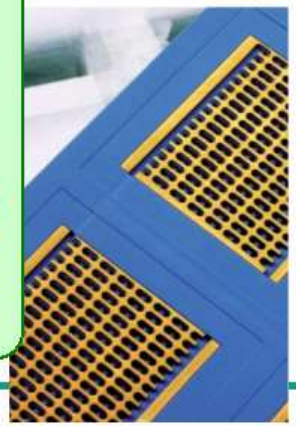




Balances:
- therm. (3x), - electr., - mass transp. (7x), - fluid. (3x), - chem. react. (3x)

optimisation PEM-electrode array





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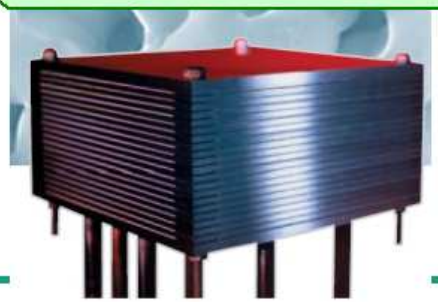

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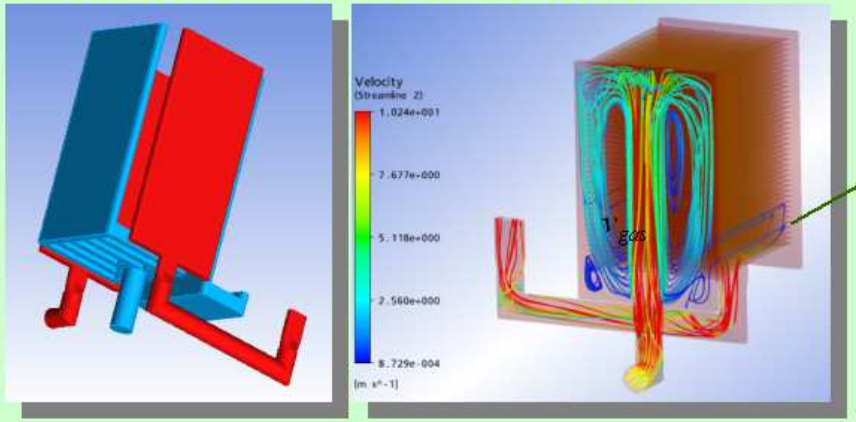
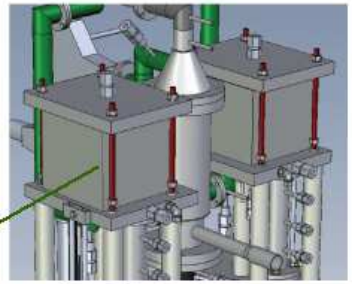
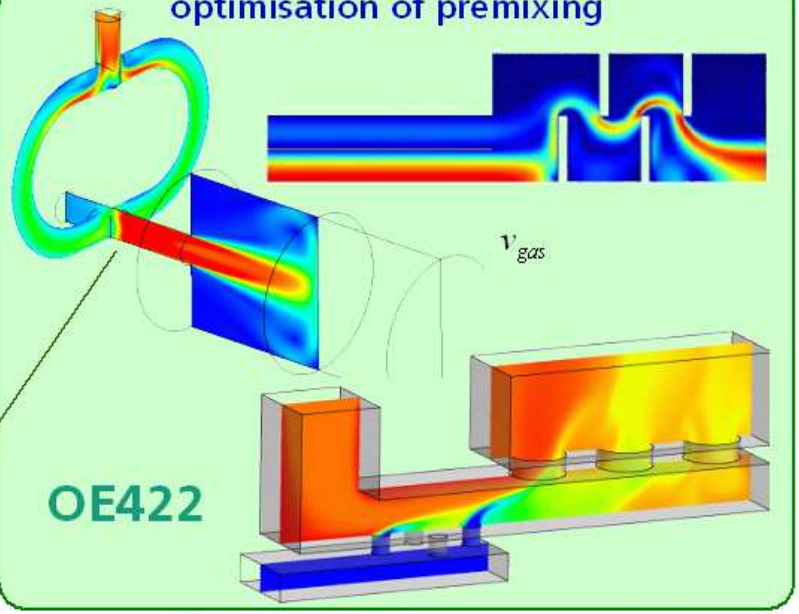
Computational fluid dynamics

optimisation of SOFC-stack gas supply





optimisation of premixing



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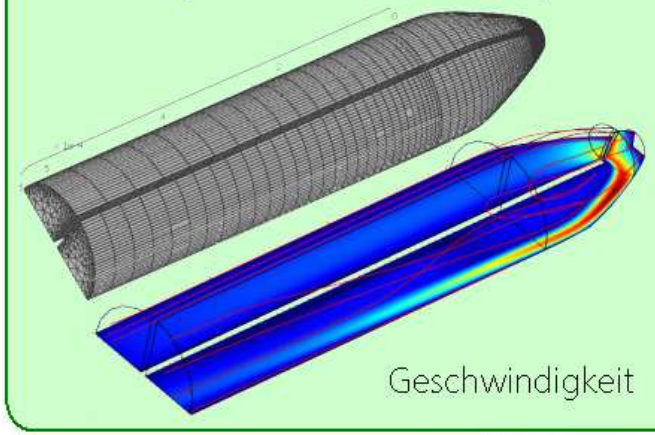
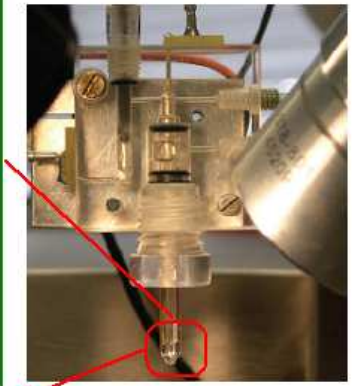
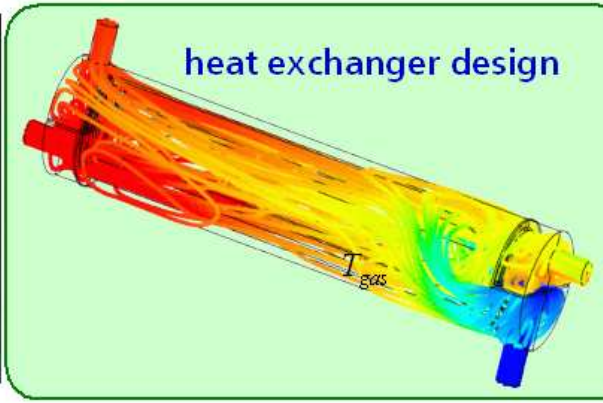
fluid analysis of elektro-chem. µ-cell





heat exchanger design



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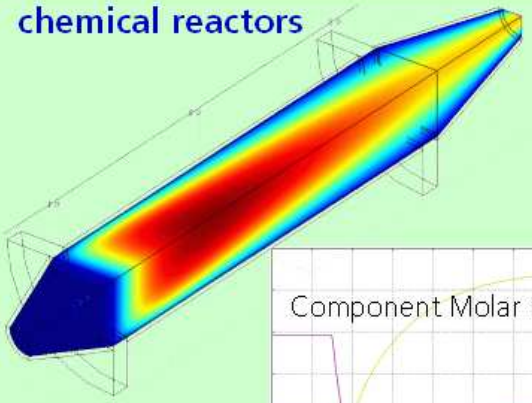
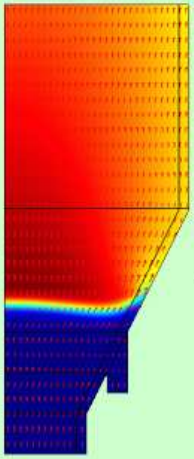
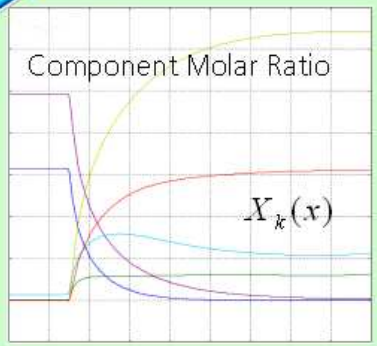
Modelling of reactive porous flow

chemical reactors



T_{sol}





Aims:
therm. load
homogen. reaction

CFD + mass transport 7 species + chem. reactions
+thermal balances (2x)

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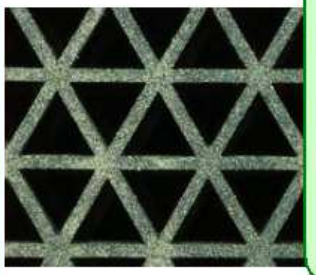
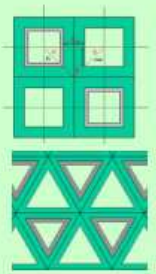
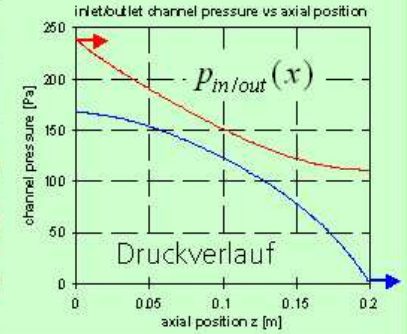


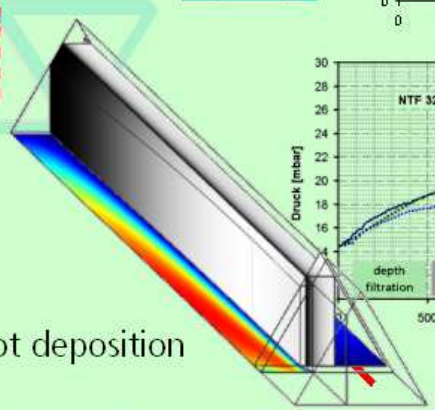
Model Diesel Particulate Filter structure

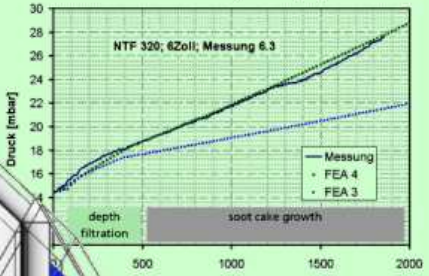
evaluation of structure variants: geometry, material



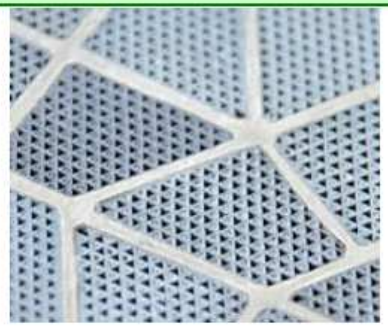


unit cell
analysis





soot deposition



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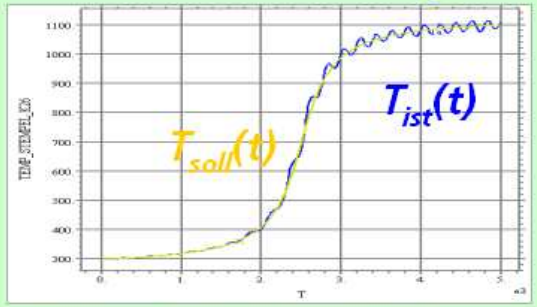
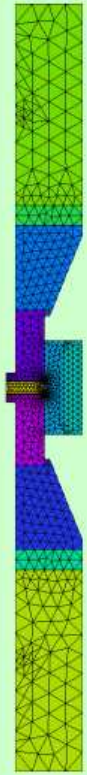
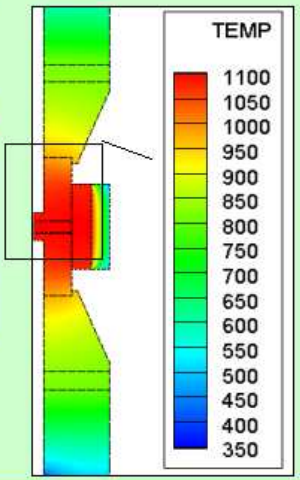
Dimensioning/Optimisation of integrated heater structures

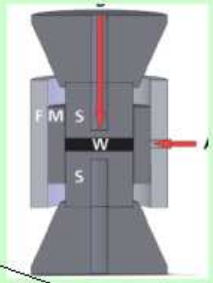
model: field assisted sintering device

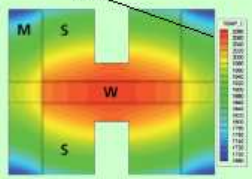


thermo-electric coupling
„moving mesh“
integrated temperature-control

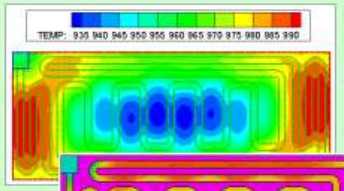






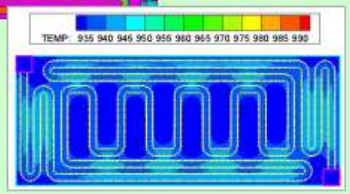


optimisation sensor heater



T_{sub}
before optimis.
$\Delta T \cong 50\,K$

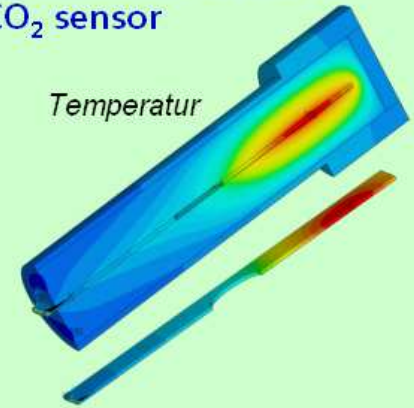
opt.
Heizleiter-
dicke b_{el}

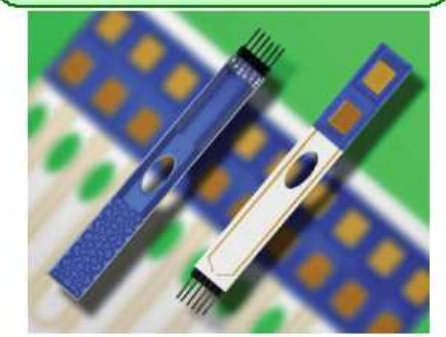


T_{sub}
after Optimis.
$\Delta T \cong 7\,K$

optimisation heater for CO_2 sensor

Temperatur





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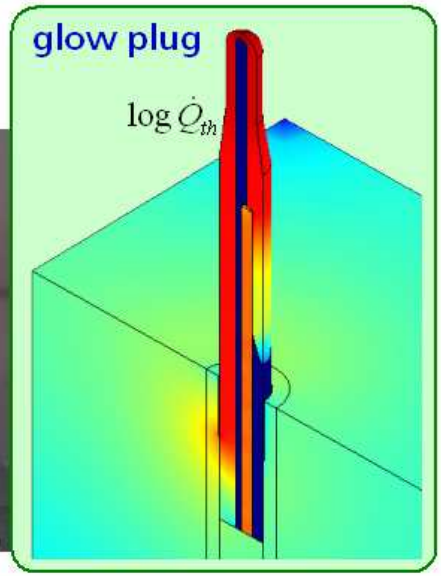
glow plug



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