Material designation:
RaFo-MF-401-E

Introduction:
This Material was developed as a ceramic foam. It is characterized by a highly porous structure. It can be realized almost each basic geometry. The ceramic matrix is based on $Al_2O_3 \cdot SiO_2$ and shows high strength. The defined ratio of pore distribution, pore size and pore volume is decisive for the very good thermal shock resistance. This enables a quick heating interval for the application process. Due to the low density, this material shows a very low specific heat storage capacity. By using this material as refractory or kiln outlining, the energy efficiency can be affected positively.

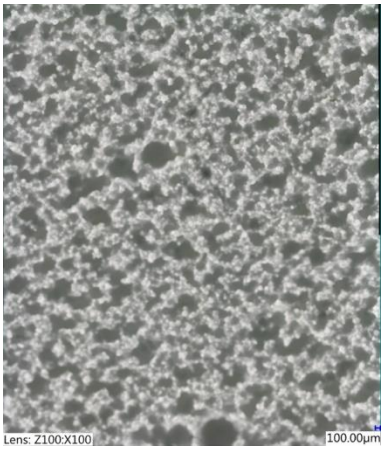

Fig. 1. Typical view of cross-section structure

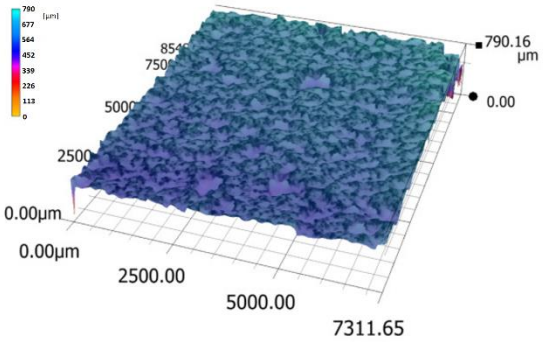

Fig. 2. Typical view of digital reconstruction of cross-section

Possible applications:
Ceramic cores for ceramic filters
High temperature refractories
High temperature furnace thermal isolation
High temperature carrier supports

Basic parameters:

Material basis:	$Al_2O_3 \cdot SiO_2$ (Mullite)
Max. operating temp. [°C]:	1600
Water absorption [%]:	55.1±8.9[1]
Open porosity [%]:	66.6±4.9[1]
Matrix density [g/cm³]:	3.62±0.38[1]
Density [g/cm³]:	1.21±0.12[1]
Young modulus [GPa]:	1.97±1[1]
Breaking strength (3-Pt) [MPa]:	1.45±0.56[1]
Breaking strength (3-Pt) after thermal shocks [MPa][2]:	1.54±1.12[1]
Permeability [l/(s*m²)]:	4.16±2.97[1, 3]
Matrix [%]/ Pore ratio [%]:	79.25/20.75

[1] *Deviation is given as ± 3 standard deviations*
[2] *Result after single thermal shock at 1000°C*
[3] *Rough estimation for initial research project needs*

Pore characteristics

Pore class [eqv.Diam]	Occurrence of Pores [%]
>0-5 µm	84.06
>5-10 µm	11.60
>10-20 µm	1.67
>20-40 µm	0.60
>40-80 µm	0.48
>80-100 µm	0.19
>100-200 µm	0.74
>200-300 µm	0.40
>300-400 µm	0.19
>400-500 µm	0.07
>500-600 µm	0.01
>600 µm	0.01

Chemical composition

(Calculated from chem. Analysis of the raw material datasheets)

Al_2O_3	89,95 %
SiO_2	9,14 %
Na_2O	0,37 %
Fe_2O_3	0,12 %
TiO_2	0,07 %
K_2O	0,35 %

Coefficient of thermal expansion (CTE)

Temp. Range [°C]	CTE [ppm/K]	Temp. Range [°C]	CTE [ppm/K]
200-1500	8.1483	1500-200	8.4639
200-400	7.013	1500-1400	9.7757
400-600	7.7313	1400-1200	9.2311
600-800	8.1518	1200-1000	9.0754
800-1000	8.6827	1000-800	8.7688
1000-1200	8.9943	800-600	8.3071
1200-1400	8.7814	600-400	7.8687
1400-1500	7.2195	400-200	6.8767