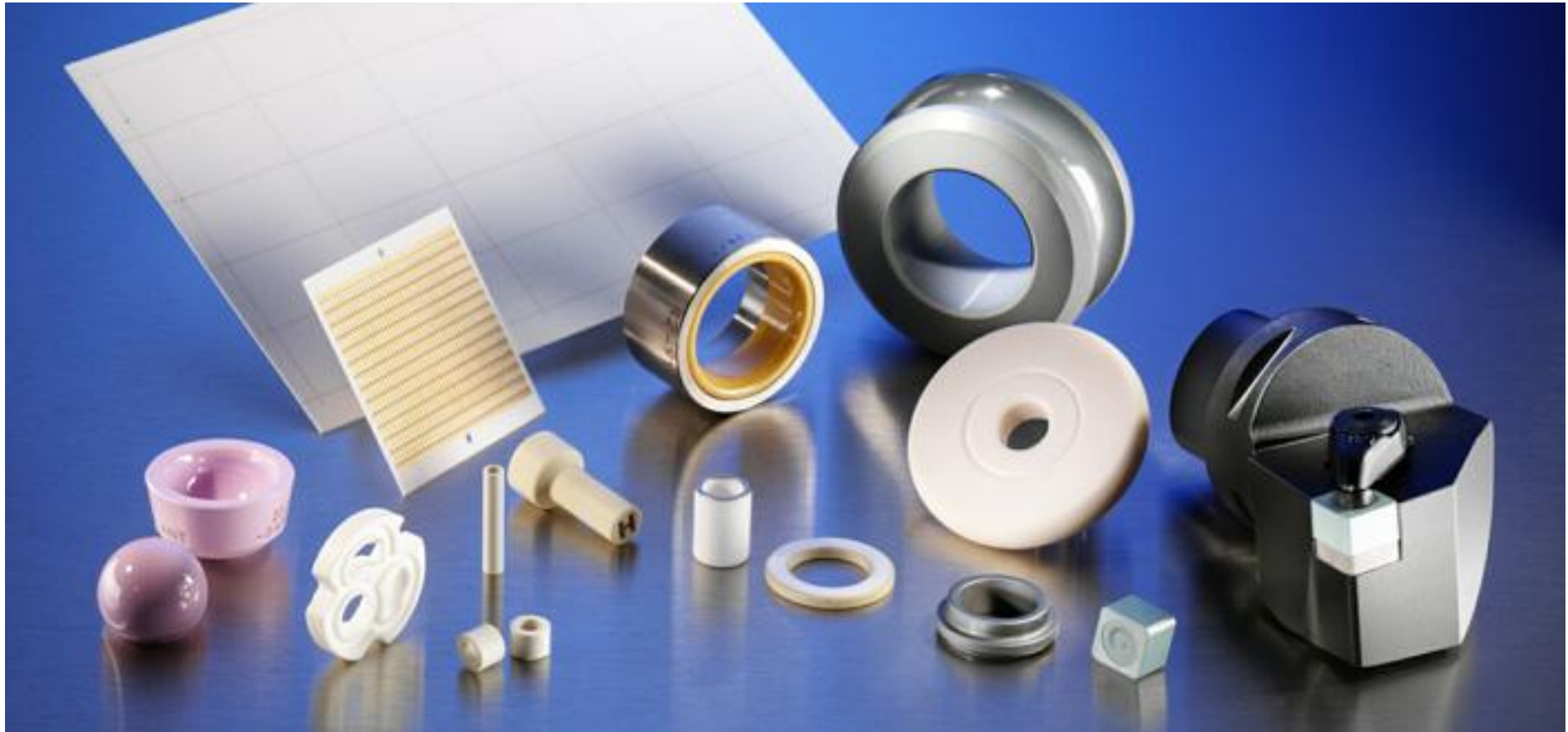


Welcome to the World of High-Performance Ceramics



The CeramTec Group



- ▶ **Sales: EUR 300 million**
- ▶ **2,900 employees**
- ▶ **17 manufacturing sites**

CA-0710-1

CeramTec International Locations



America:

USA
Brazil
Mexico

Africa:

South Africa

Europe:

Germany
France
Great Britain
Italy
Poland
Russia
Scandinavia
Spain
Czech Republic

Asia:

China
Korea
Malaysia
India
Japan

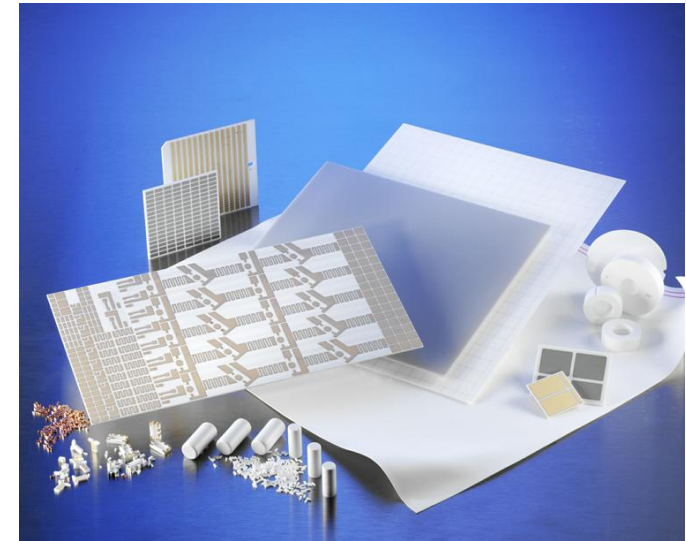
Electronic Applications Division

▶ **Rubalit® and Alunit® ($\text{Al}_2\text{O}_3/\text{AlN}$) substrates for:**

Hybrid and microelectronic technologies,
power electronics,
and passive components.

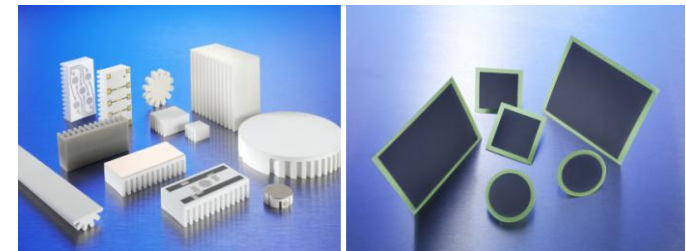
Available in lasered, stamped, green-scored, and dry-pressed versions.

Depending on the application, metallized products are also offered.



▶ **Rubalit® resistor cores for:**

Carbon film, metal-coated and metal-oxide resistors, with emphasis on high-performance and precision resistors.



▶ **CeramCool® ceramic heat sink**

▶ **CeramCell fuel cell components**

CeramTec in LED Applications

CeramCool® - die Basis für innovatives Wärmemanagement

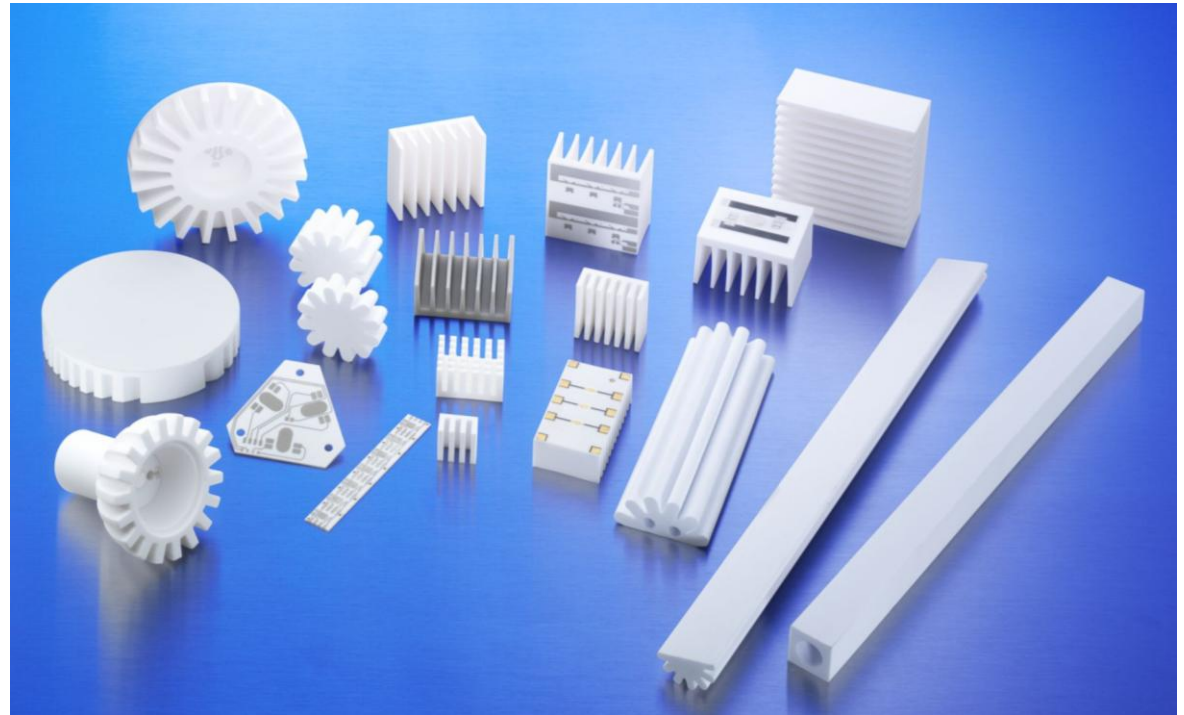
**Dr. Alexander Dohn,
Geschäftsbereich Elektronische Anwendungen,
Marktredwitz**

CeramTec

CeramCool® - Heat Sink made of Advanced Ceramics

Perfect Ceramic Properties

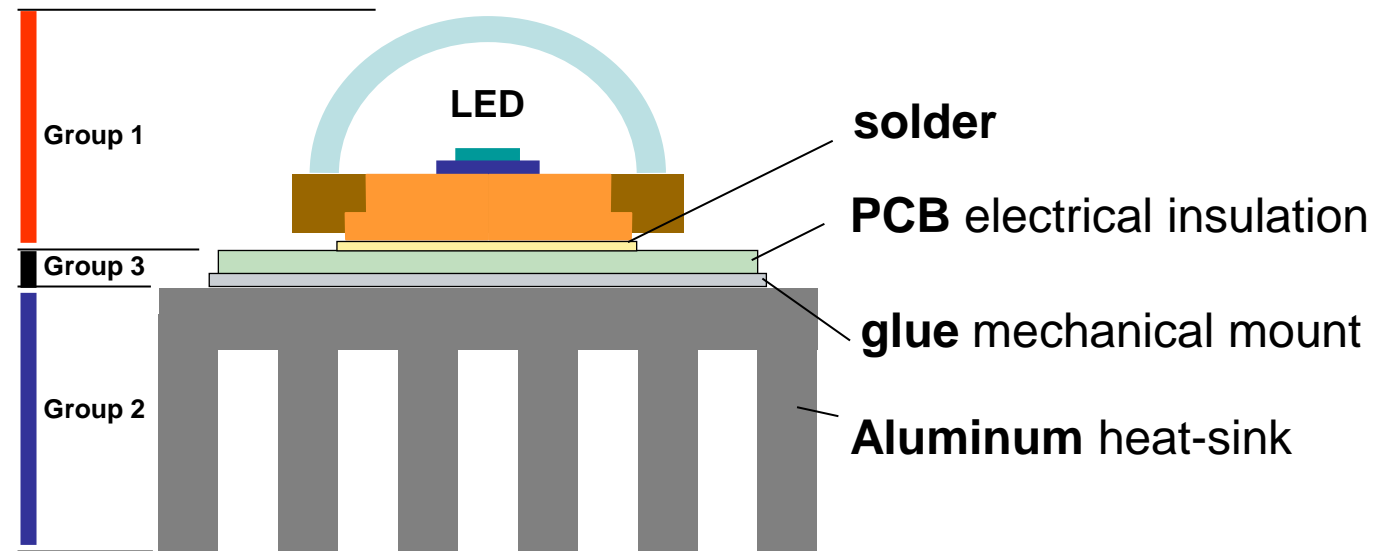
- Two in one: electrical insulation and thermal management
- Suitable for every environment
- Simplified LED system
- No TCE mismatch
- For higher LED performance: more lumina per Watt
- For longer lifetime of LED



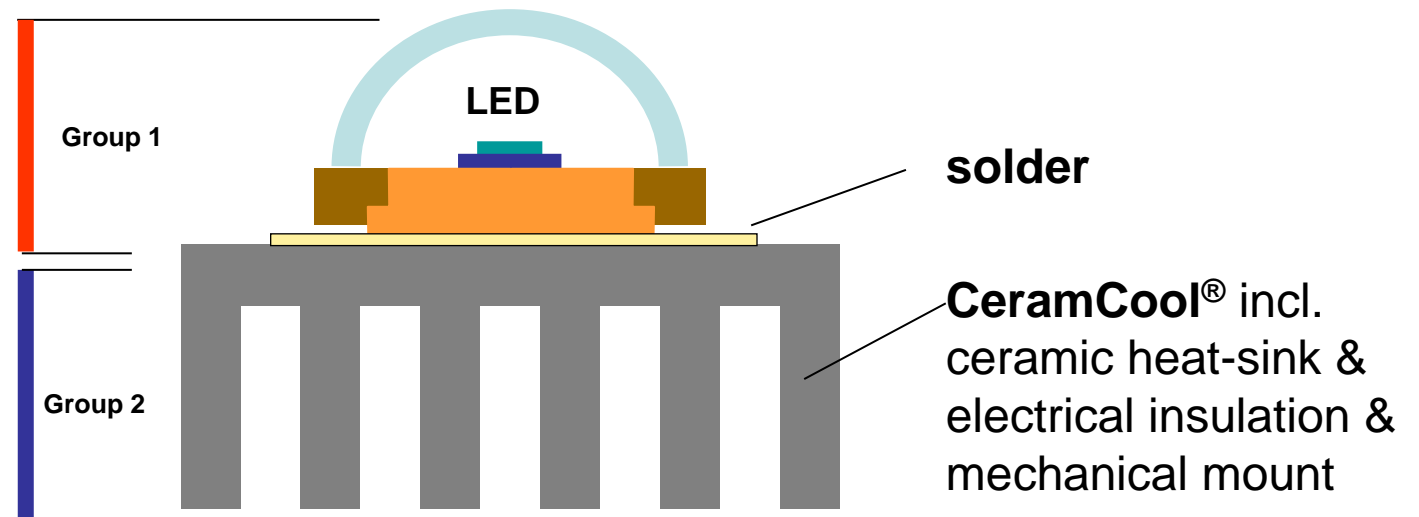
CeramTec

What excels CeramCool®?

Standard concept:
min. 5 components!



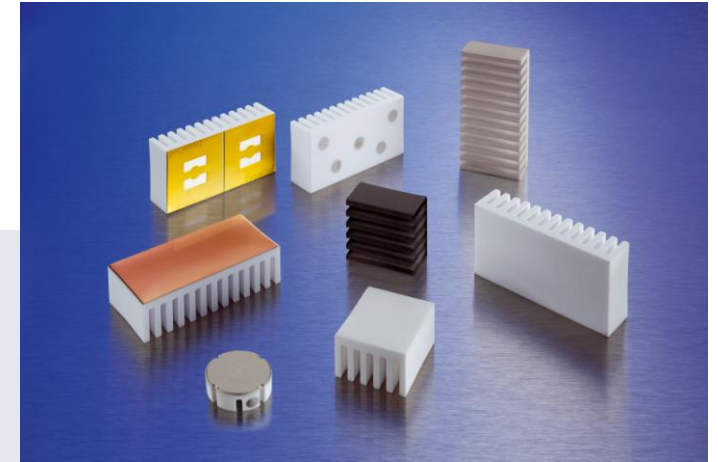
CeramCool®:
max. 3 components!



CeramTec

Ceramic Heat Sink Material Systems

- ▶ Alumina Rubalit® 708S 24 W/mK
- ▶ Aluminum Nitride Alunit® 180 W/mK
- ▶ Additional materials available
- ▶ Combinations with metallization systems
- ▶ ROHS compliant



CeramTec

1. Simulation of Die Temperature

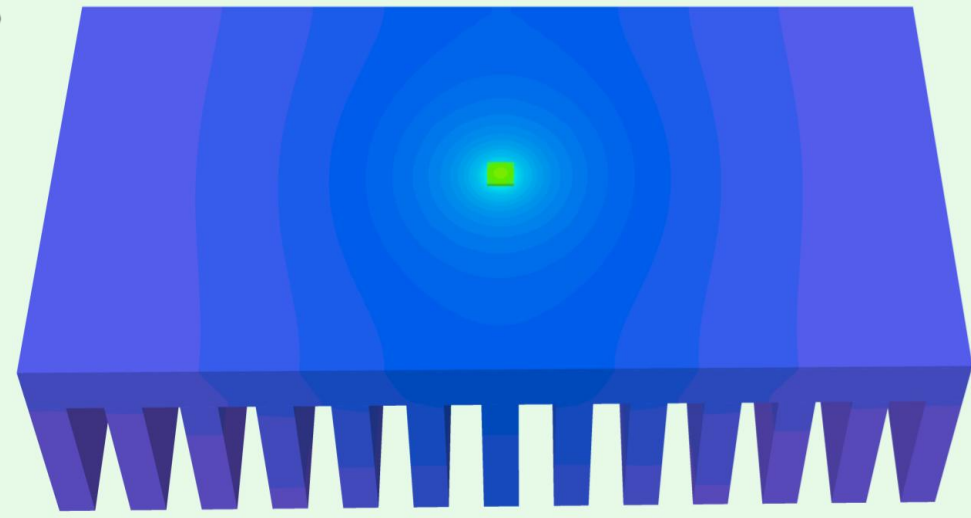
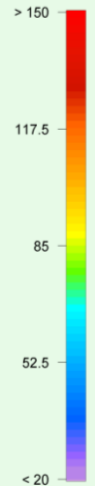
die: 1.5 *1.5 mm², 10W excess heat, 5.5 m/s forced air

aluminum

glue: 50 μm, 2 W/mK

$T_{\max \text{ die}} : 169 \text{ }^{\circ}\text{C}$

Temperature (degC)

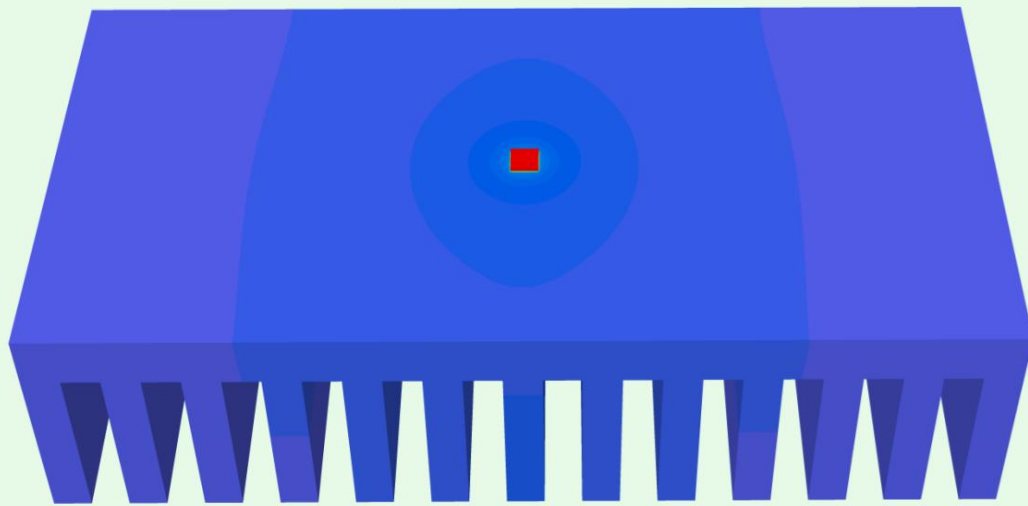


$T_{\max \text{ die}} : 82 \text{ }^{\circ}\text{C}$

alumina

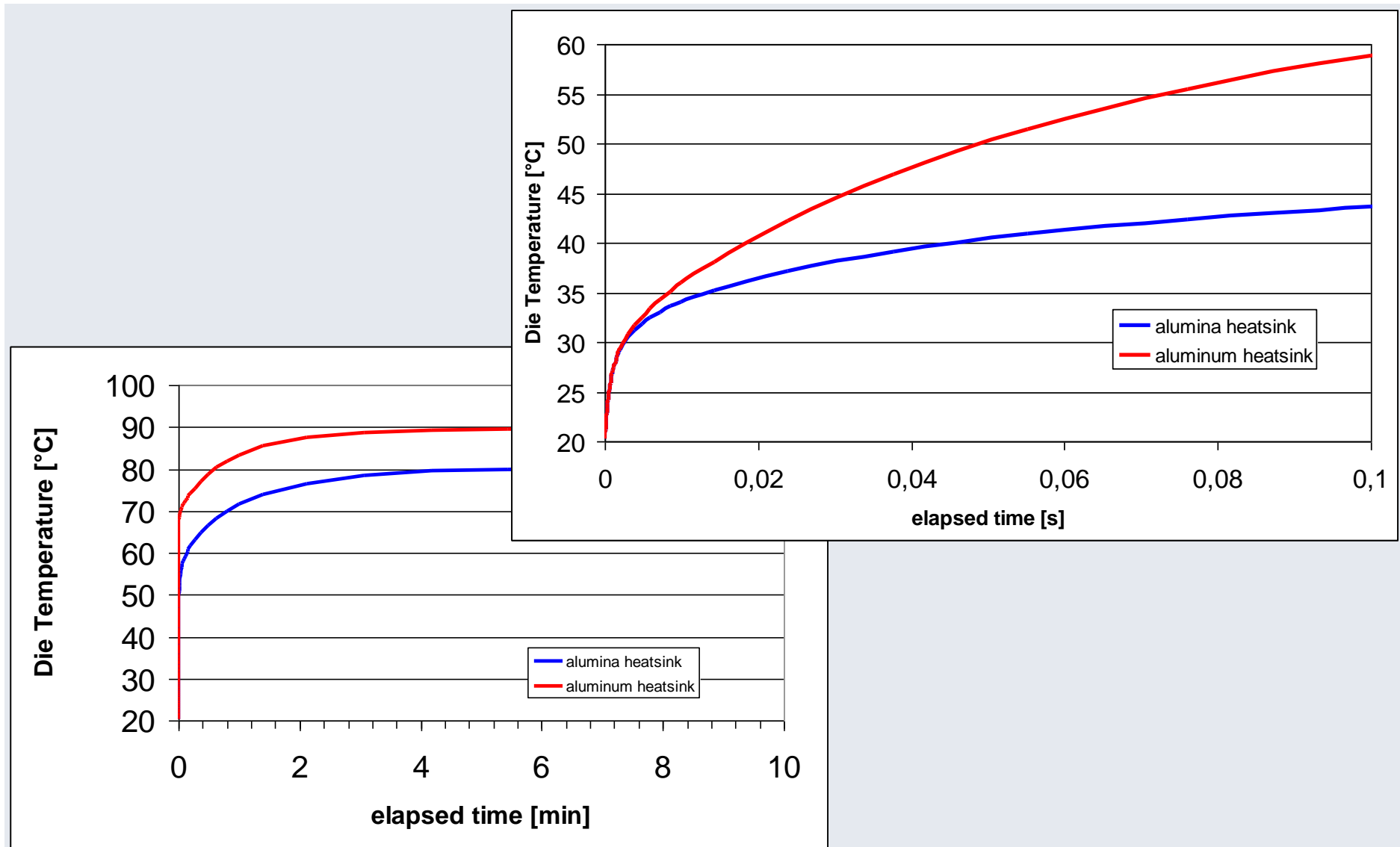
layer: Cu 200 μm

solder : 50 μm, 60 W/mK



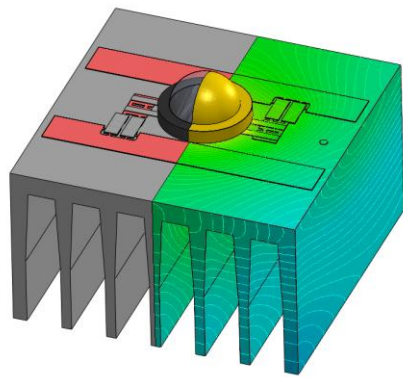
Fraunhofer Institut, Nuremberg Germany

2. Simulation of Dynamic Die Temperature Increase

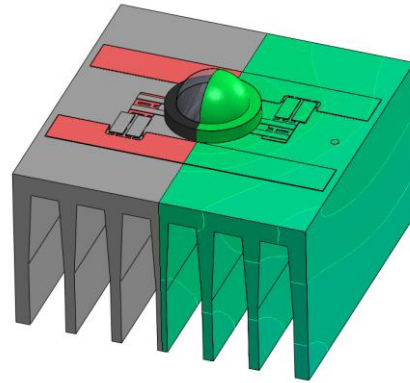


Fraunhofer Institut, Nuremberg Germany

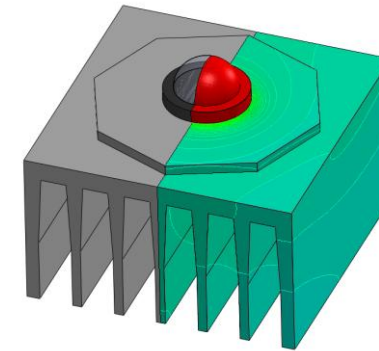
Total Thermal Resistance (R_{tt}) System Comparison



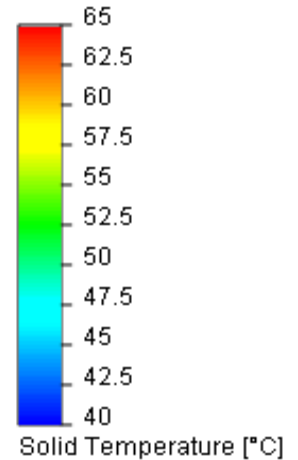
Rubalit®



Alunit®



Aluminum & PCB



Dimension: 38 x 38 x 24 mm

$$\text{Rubalit}^{\circledR} : (60^{\circ}\text{C}-20^{\circ}\text{C})/3.61\text{W} = R_{tt} = \underline{\underline{11.1 \text{ K/W}}}$$

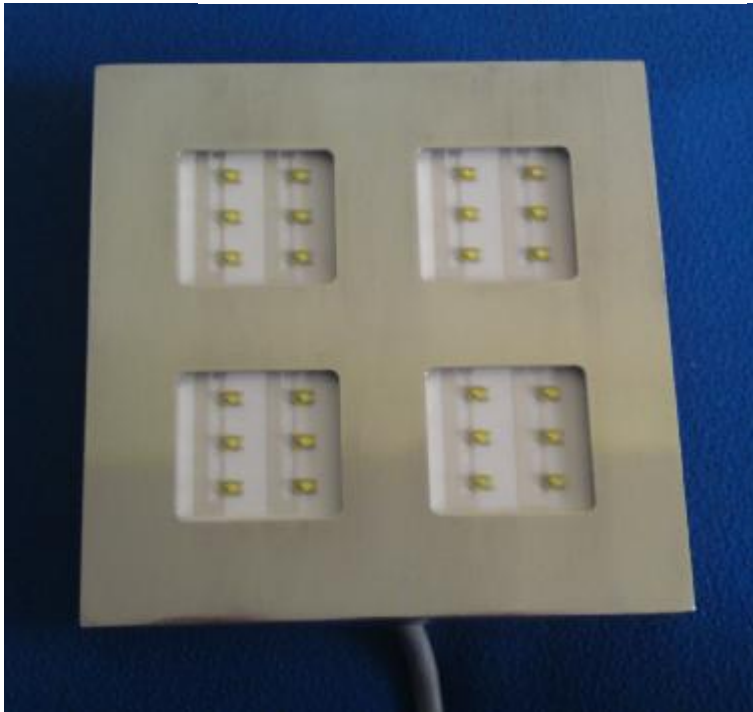
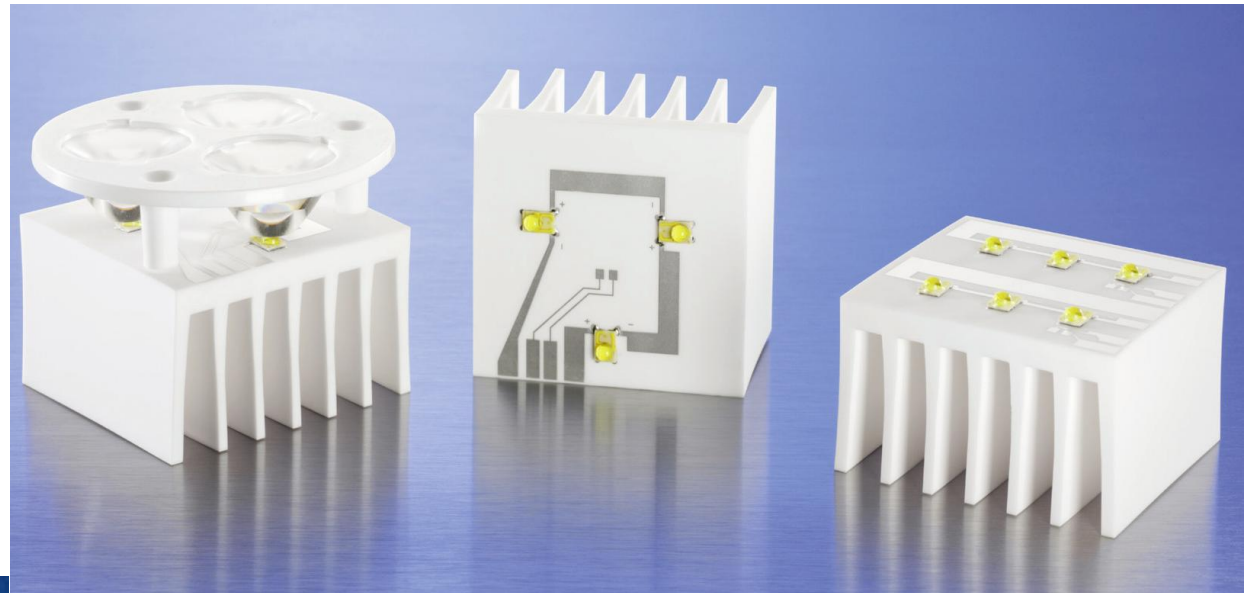
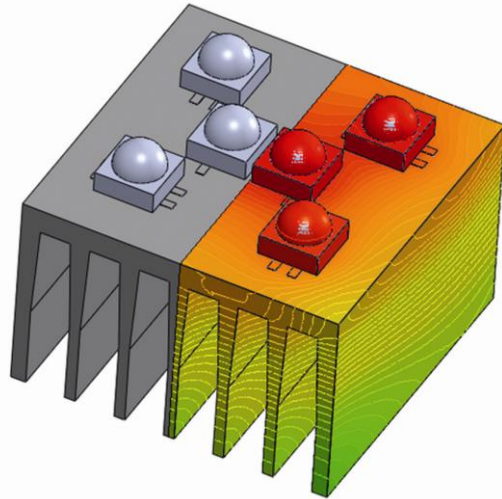
$$\text{Alunit}^{\circledR} : (51^{\circ}\text{C}-20^{\circ}\text{C})/3.61\text{W} = R_{tt} = \underline{\underline{8.6 \text{ K/W}}}$$

$$\text{Aluminium \& PCB} : (66^{\circ}\text{C}-20^{\circ}\text{C})/3.61\text{W} = R_{tt} = \underline{\underline{12.7 \text{ K/W}}}$$

Europe Altair Engineering GmbH, Germany

CeramTec

CeramCool® - Cube for Modular LED Arrays

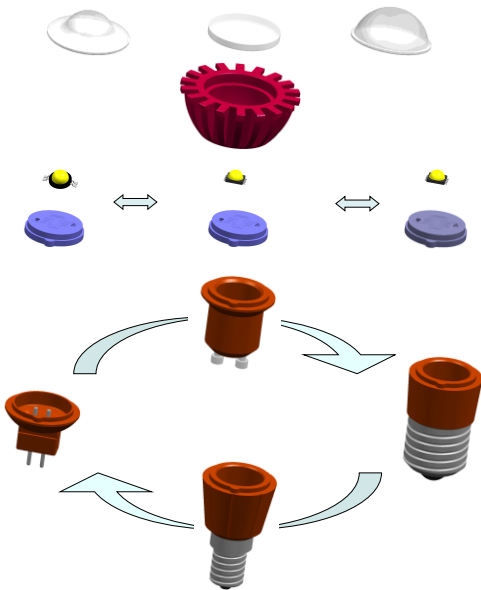
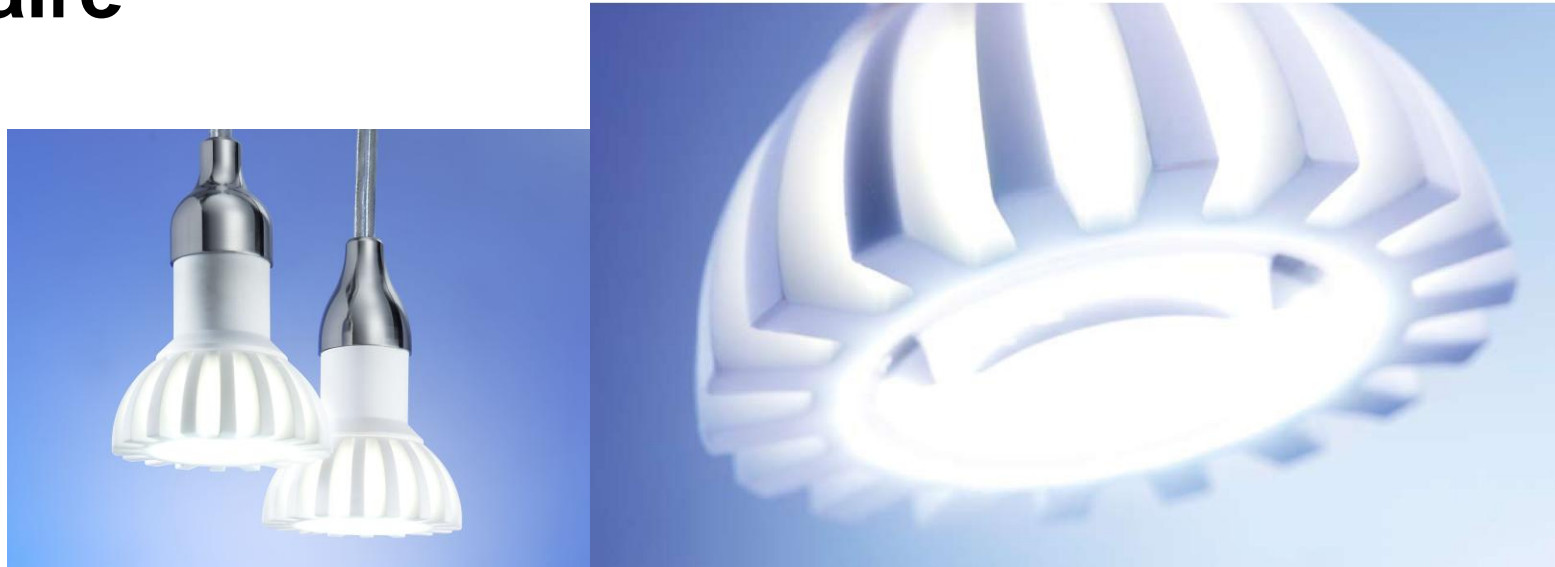


For Various Lighting Solutions

- Independent modules
- Unlimited scale
- For every environment
- Electrical circuits without thermal barriers directly on CeramCool®
- Chip on heat sink

CeramTec

CeramCool® - LED Lamp Kit as Lamp or Luminaire

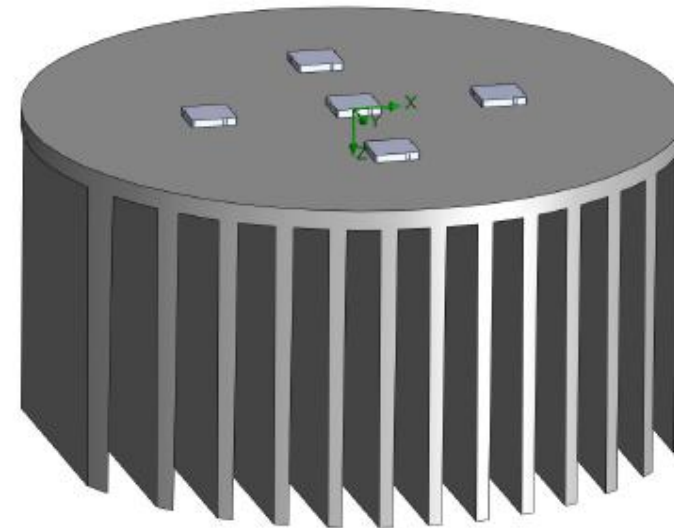
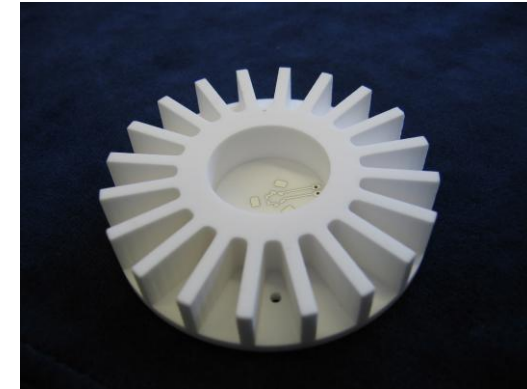


Design Plus Performance

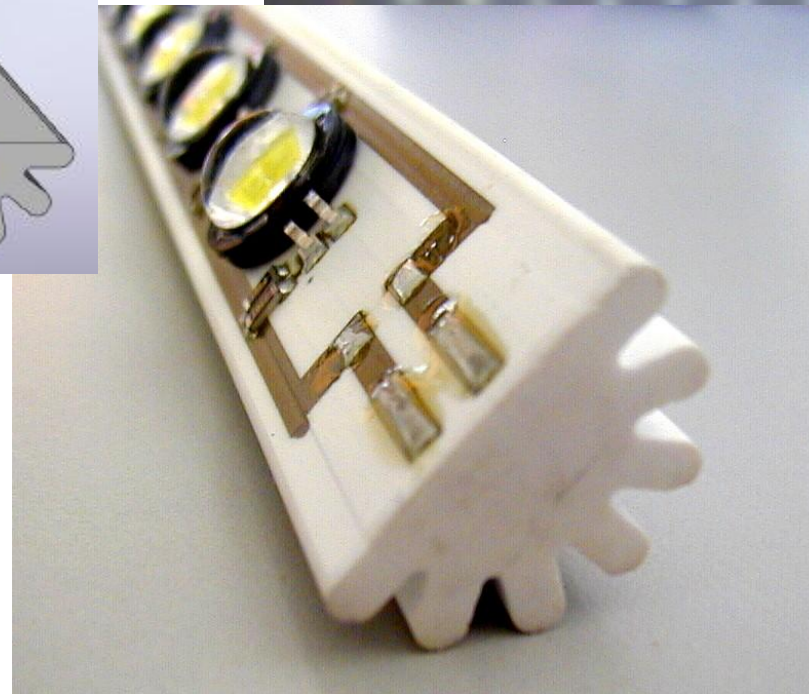
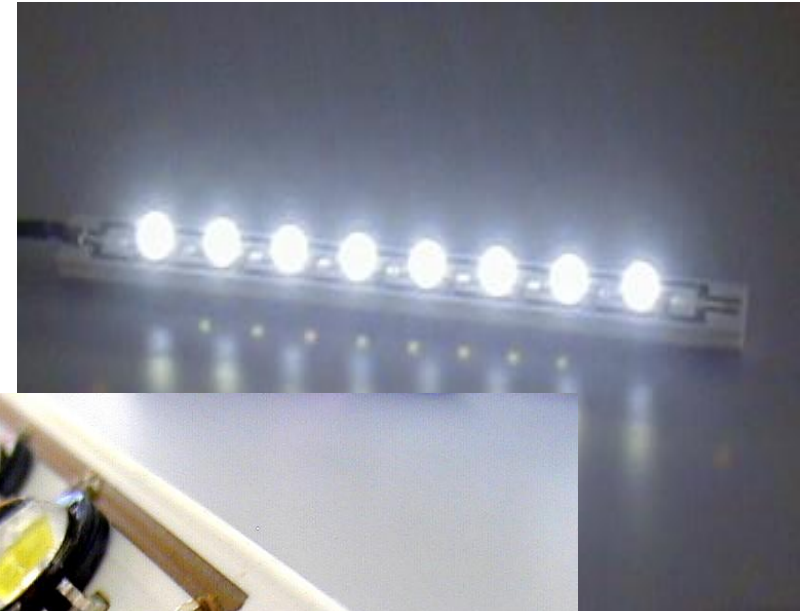
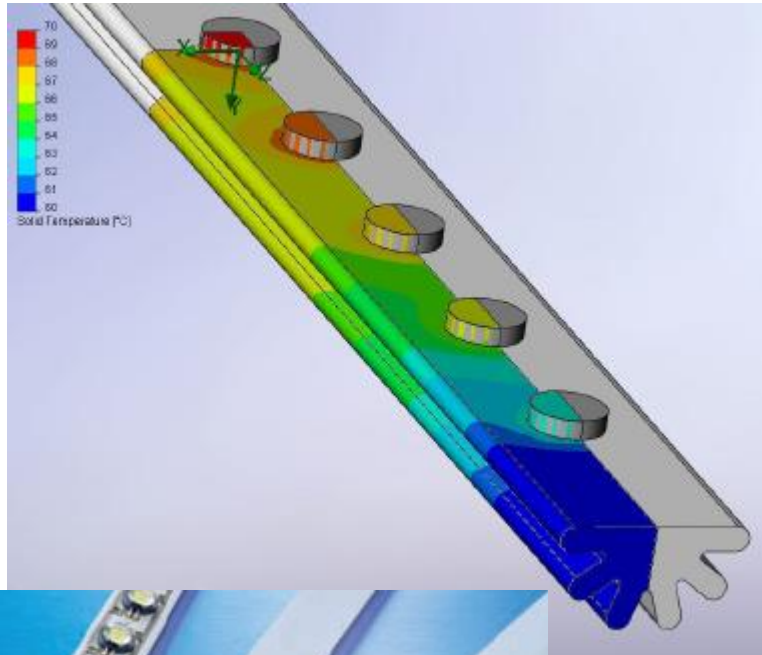
- Thermally pre-optimized
- Up to 25 % better heat management than aluminum and PCB
- Choice of ceramic components
- For customer-specific combinations
- Simple and safe class II insulation
- Ready for 10 W LED
- Only ceramics
- Fascinating indirect light

CeramCool® - Round

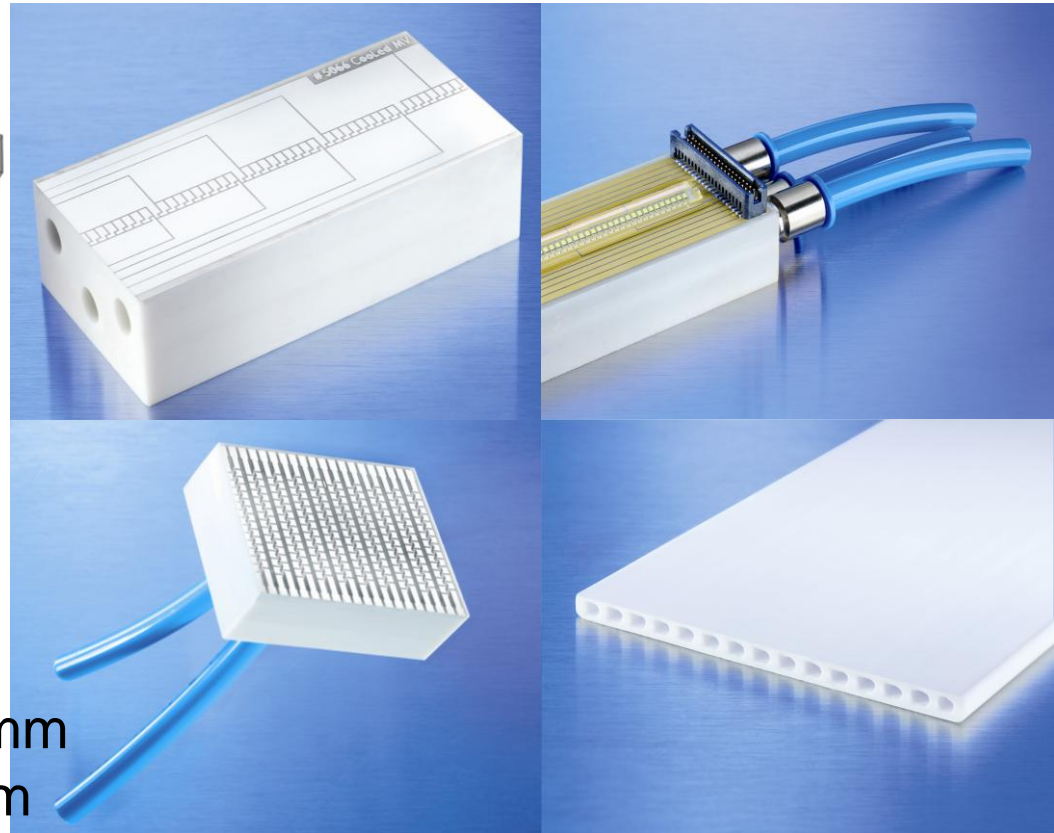
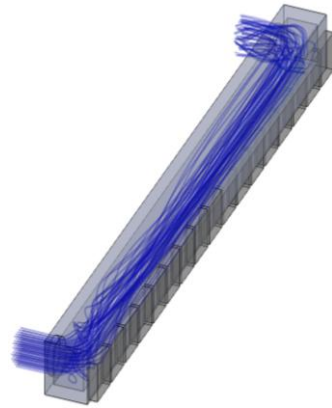
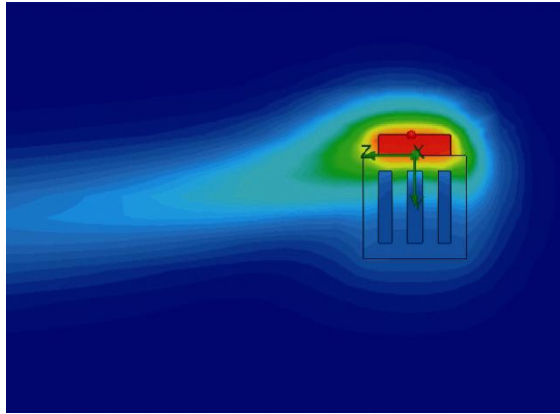
Products and Concepts



CeramCool® - Linear



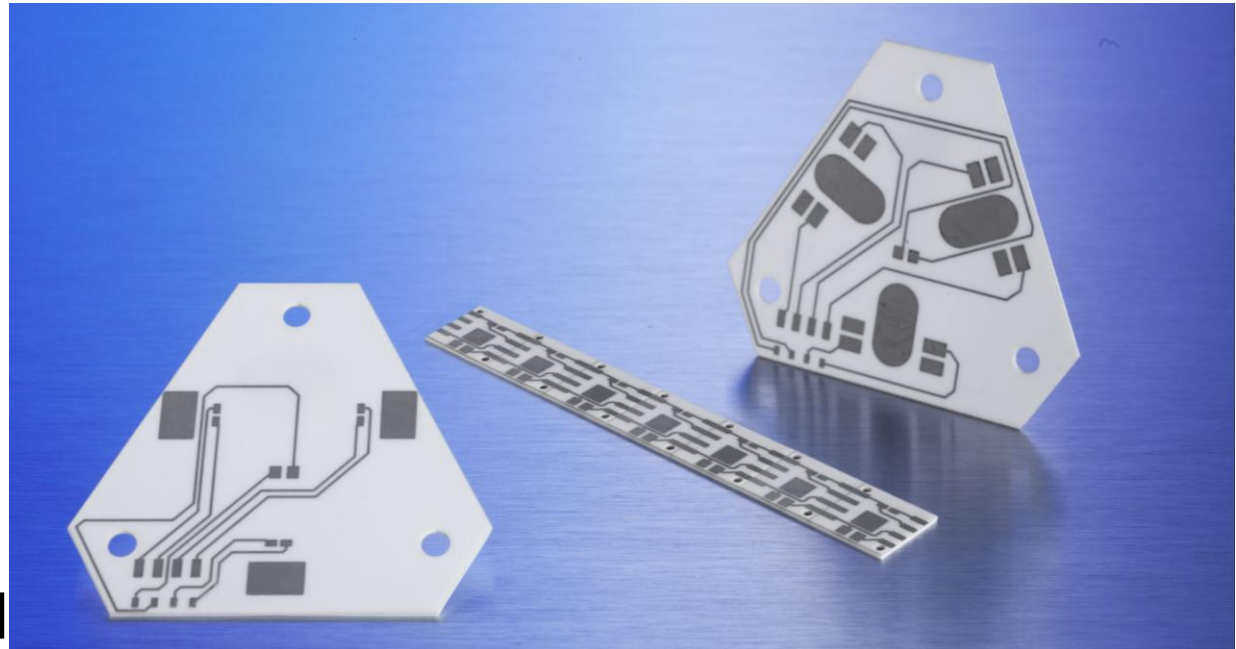
CeramCool® - Liquid Cooling for Industrial Applications



Extreme Power Density

- Best cooling system e.g.
Rubalit® ceramics 290 W on 120 mm
Alunit® ceramics 640 W on 120 mm
- Powerful packing density
- Every cooling liquid
- For every environment
- Electronic circuits without thermal barriers directly on CeramCool®
- Chip on heat sink

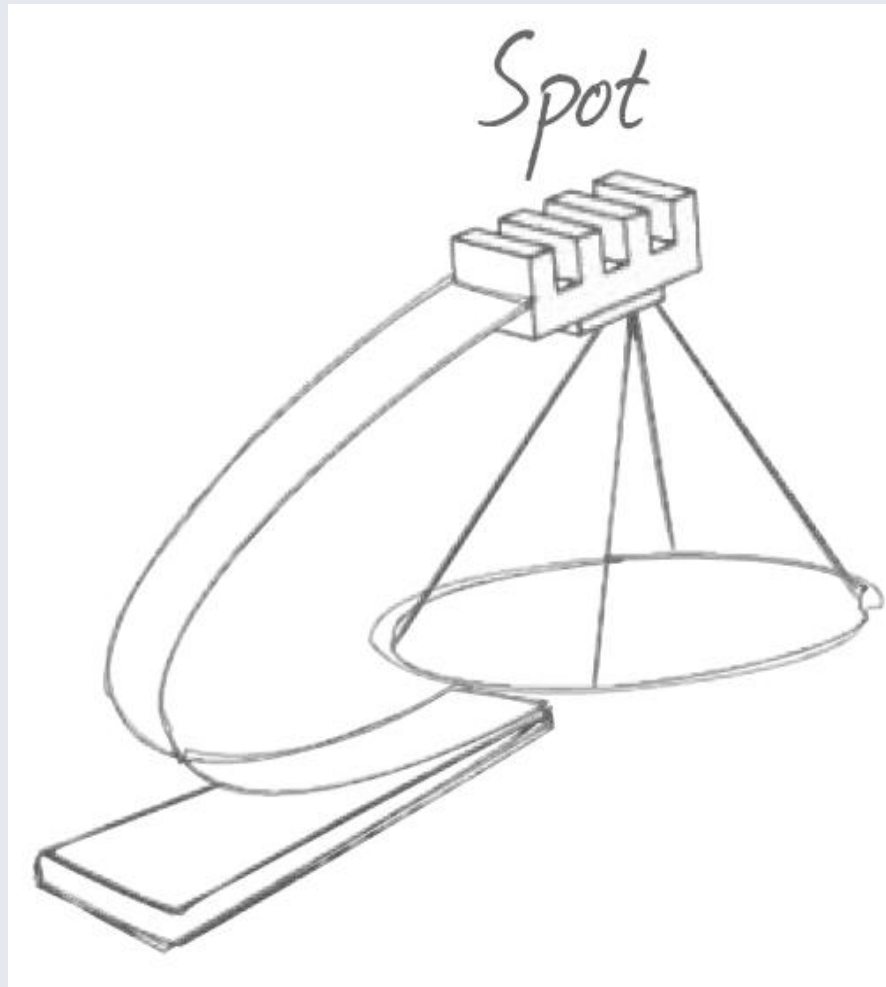
CeramCool® - Submounts for Optimizing LED Systems



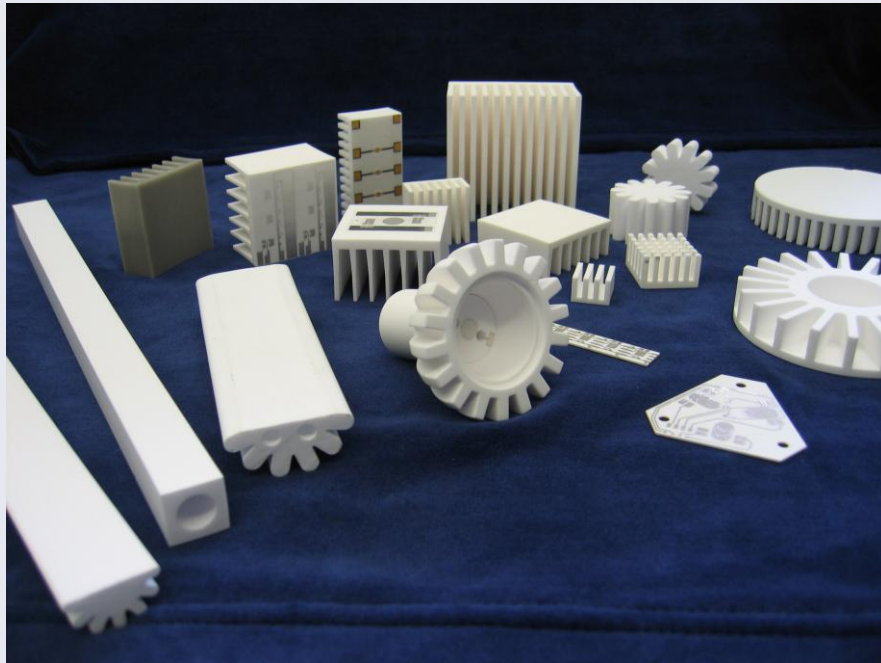
Chip on Ceramic Board

- Most efficient area of heat dissipation
- Electrical insulation, thermal conductivity, and electrical circuit
- Improving new and existing LED systems
- No galvanic corrosion
- Ceramic PCB (Printed Circuit Board)
- Low R_{tt} total thermal resistance

Be Inspired for Your Application!



Vielen Dank für Ihre Aufmerksamkeit



CeramTec AG

Electronic Applications Division

CeramTec-Weg 1

D-95615 Marktredwitz

electronic_applications@ceramtec.de