

New opportunities for scaffold design by additive manufacturing

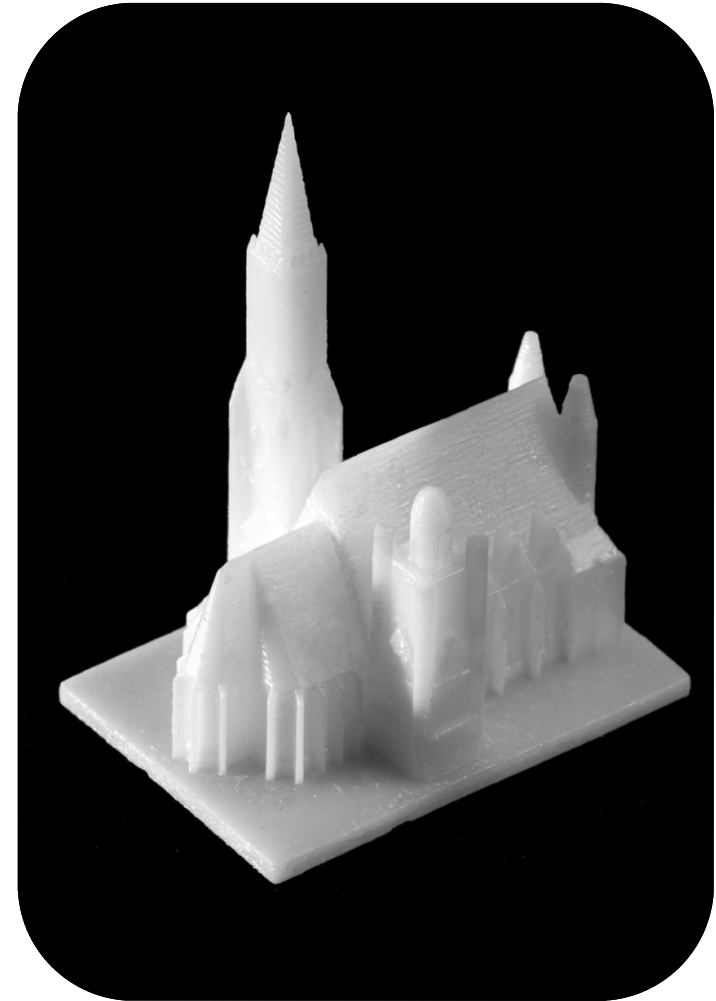


Martin Schwentenwein

Sofia, 13.10.2015

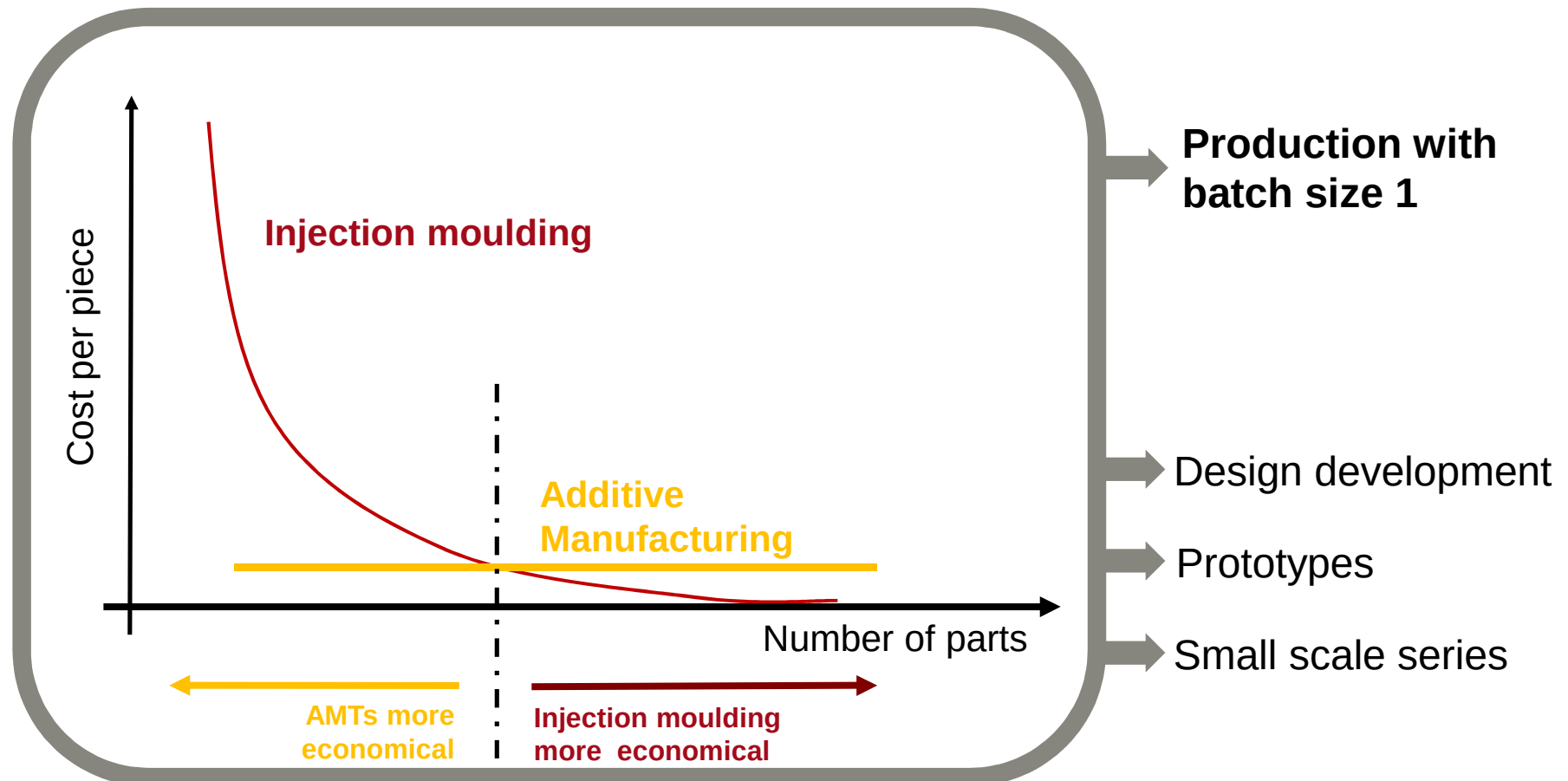


- Spin-off of the Vienna University of Technology
- System provider for AM of high-performance ceramics
- Since 2011
- Lithography-based Ceramic Manufacturing (LCM) process
- 19 employees



St. Stephen's Cathedral in Vienna

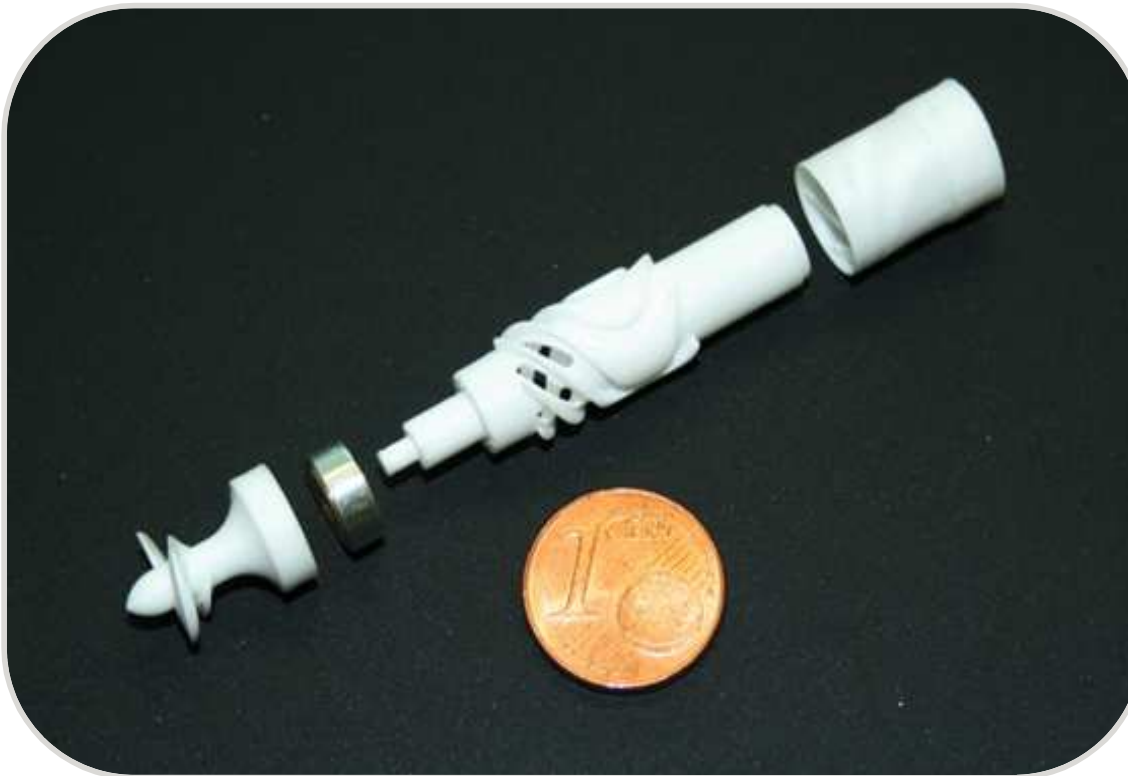
Potential:



Heartpump

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- The heartpump is running on trial on a scale of 2:1
- Until now more than 15 design variations exist



Source: TU Wien

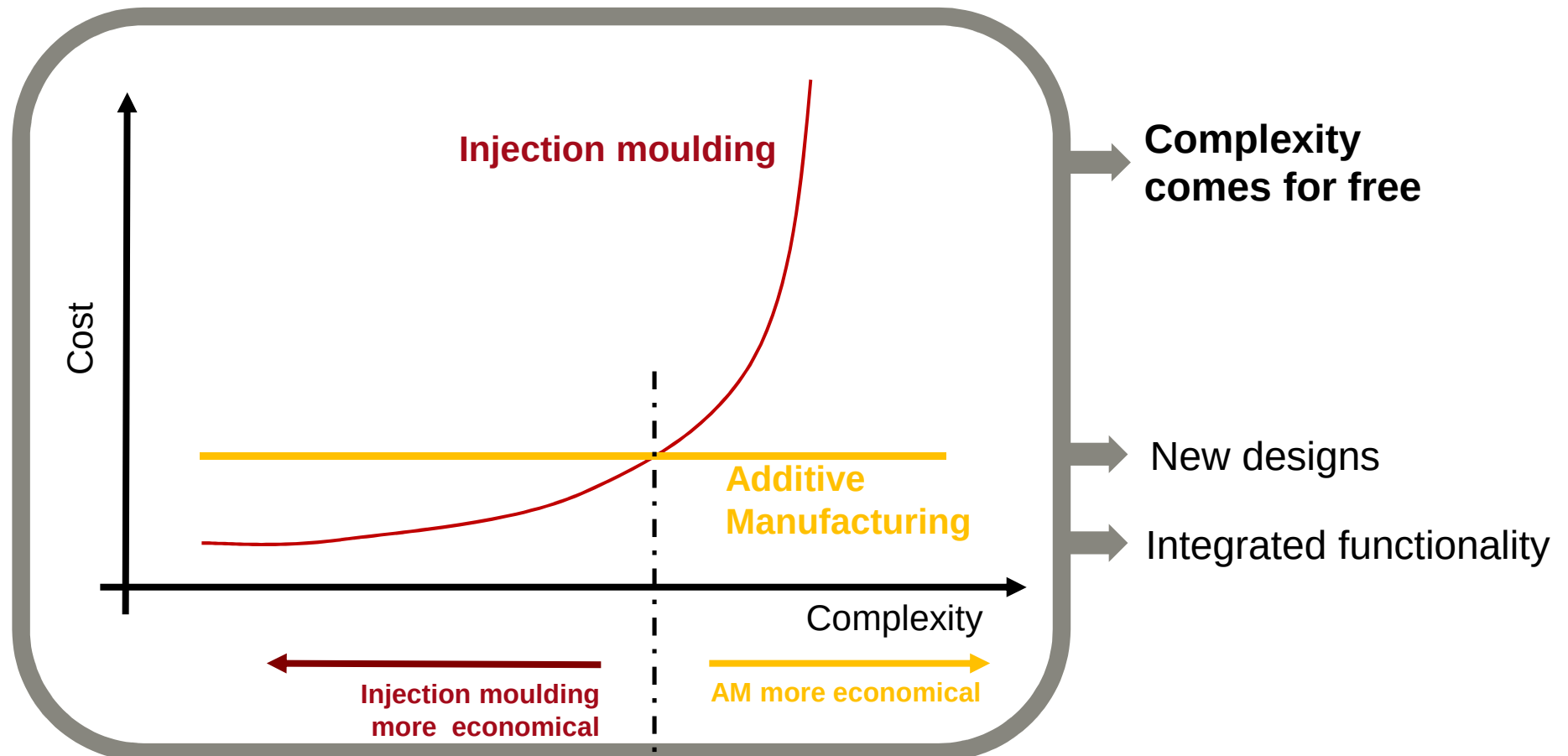


Contact:

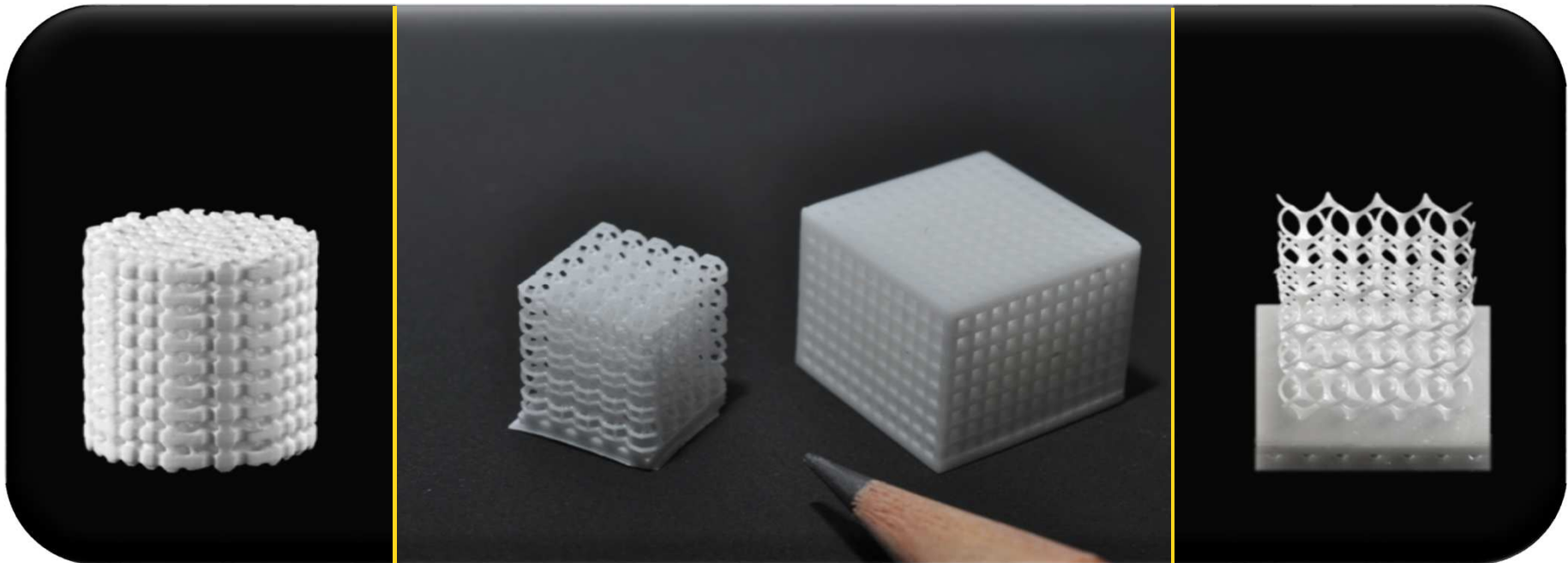
Ao.Prof. Dr. Margit Gföhler
www.ikl.tuwien.ac.at/mel/



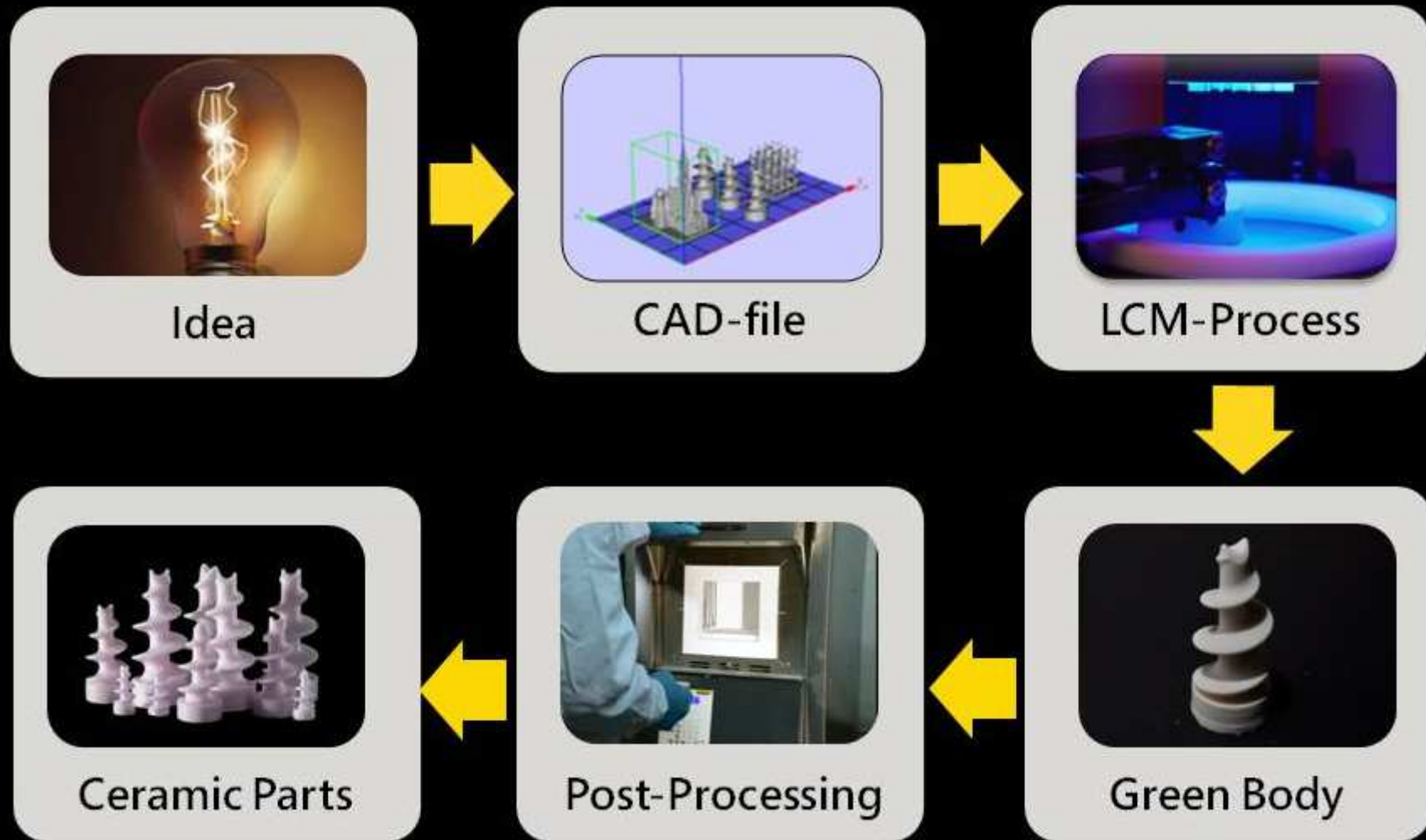
Potential:

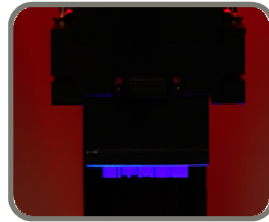
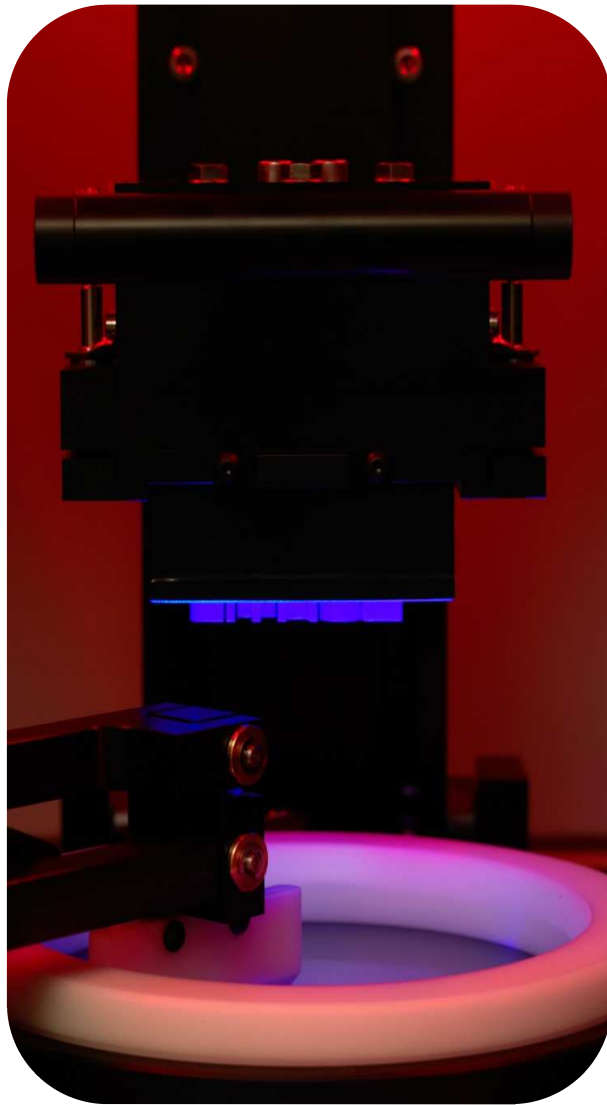


Applications: biomedical applications, catalysts, light weight structures

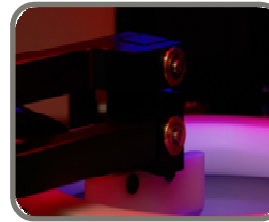


- Advantages:**
- Defined open cell
 - Variation of the unit cell
 - Strut thickness < 150µm

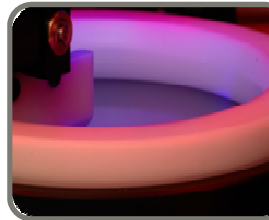




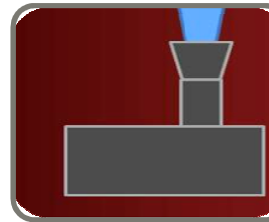
Building platform



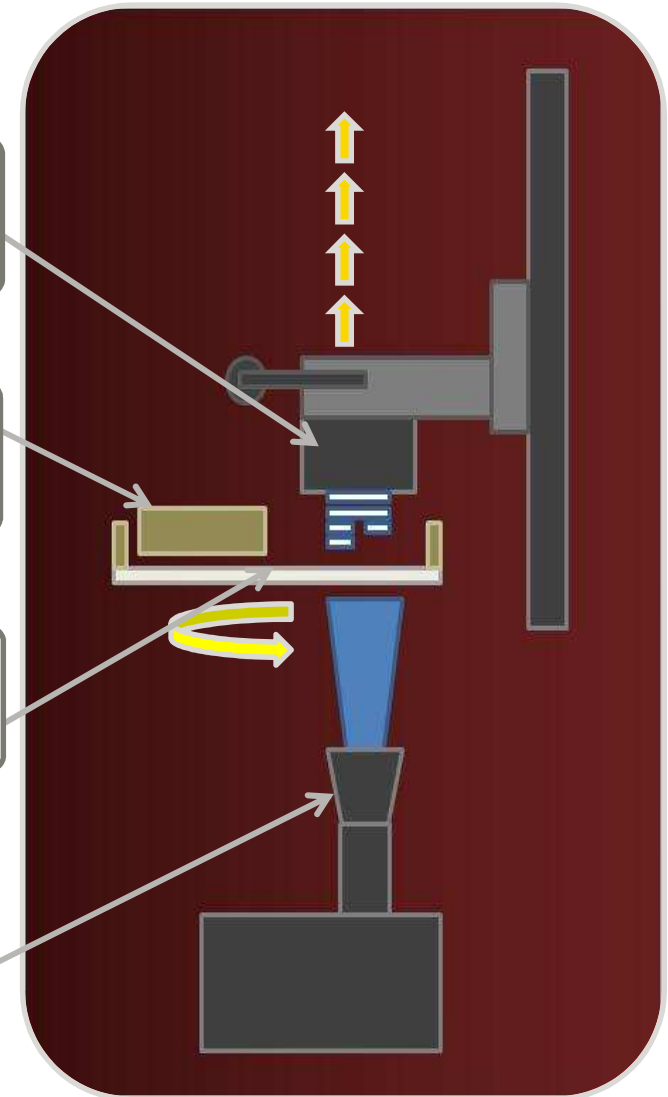
Wiper blade



Vat



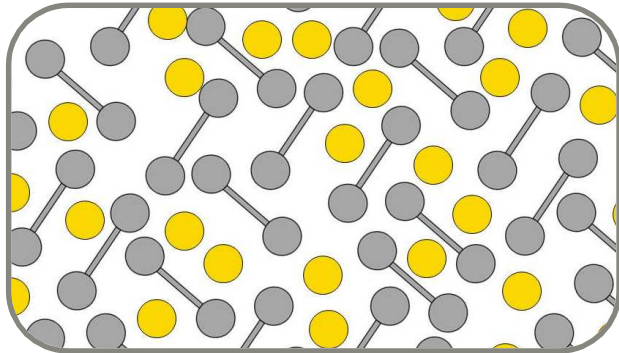
Light engine



Photopolymerization

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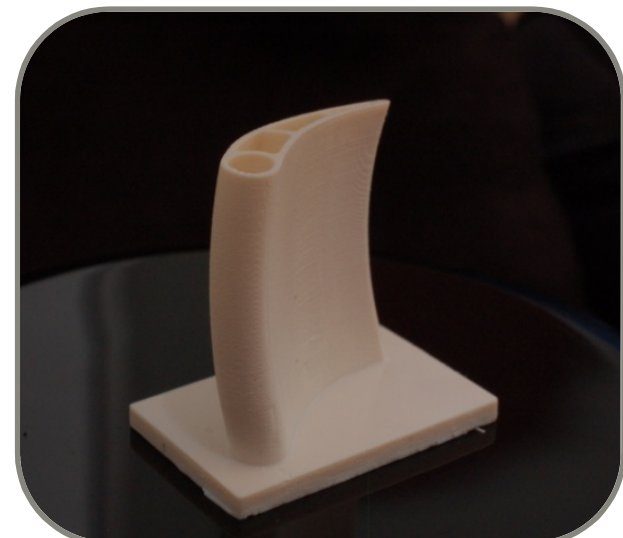
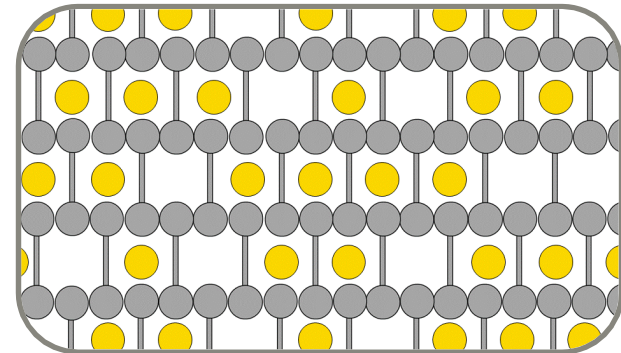
Slurry

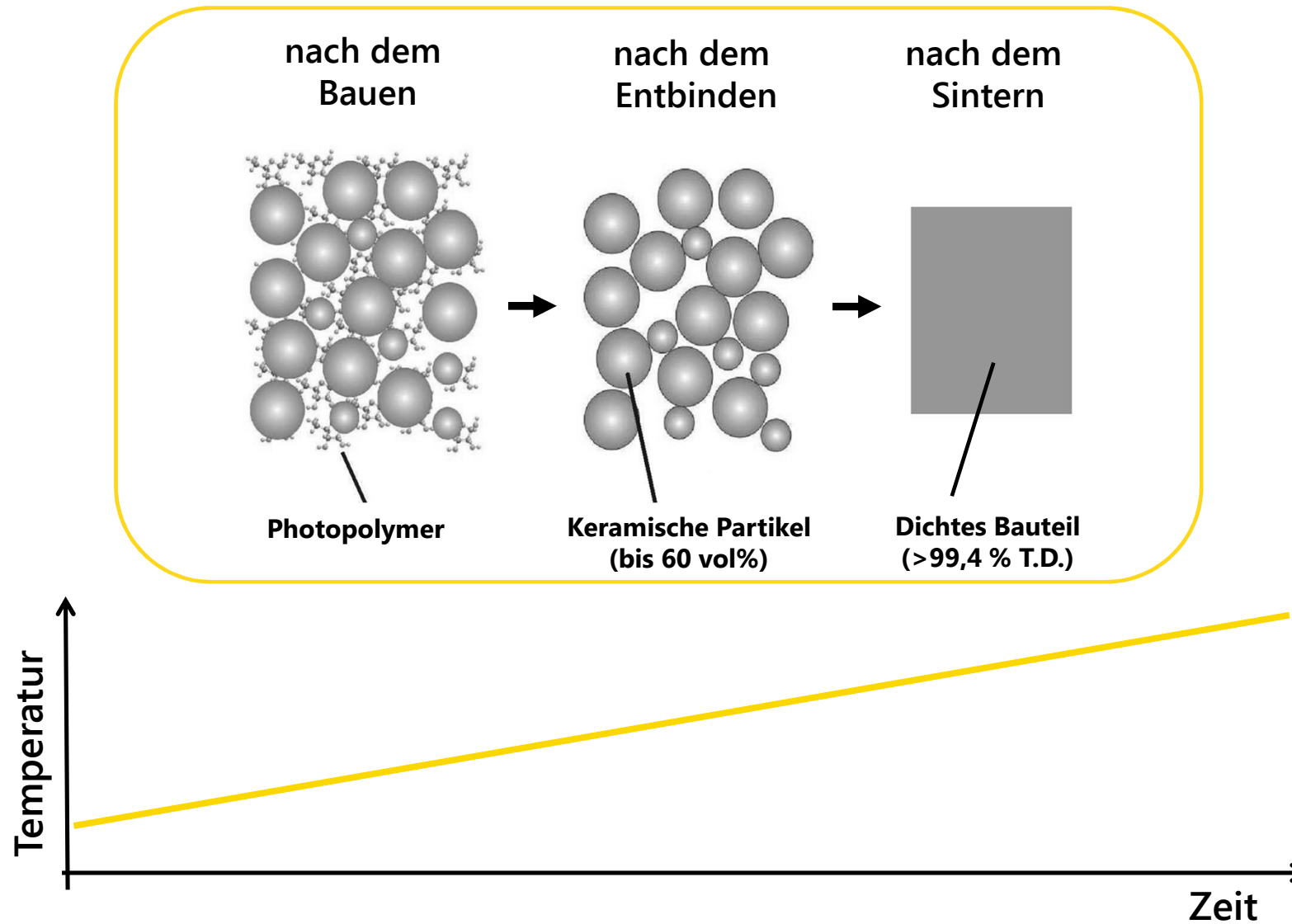


Monomer
Ceramic particle



Green part

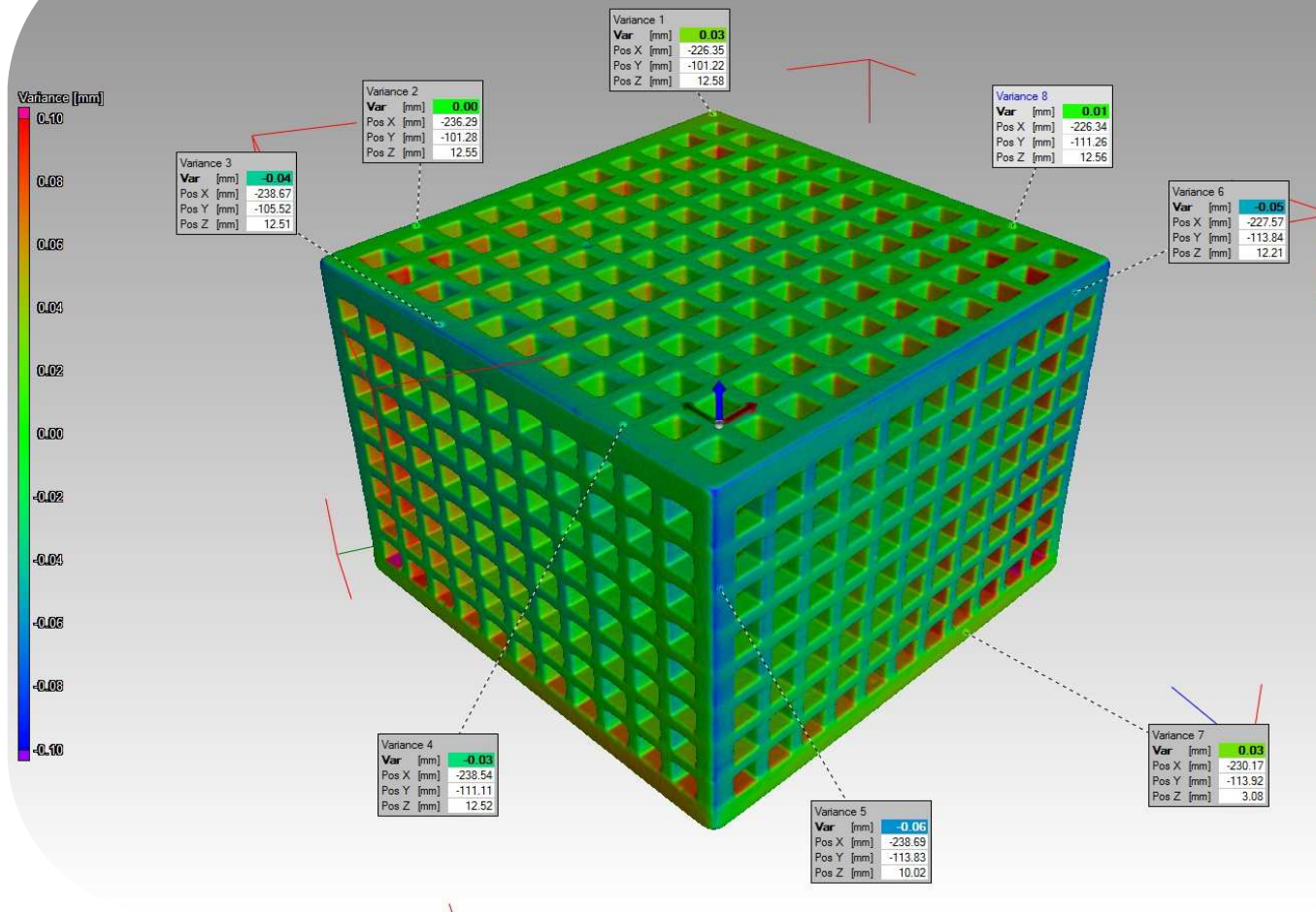
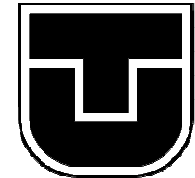




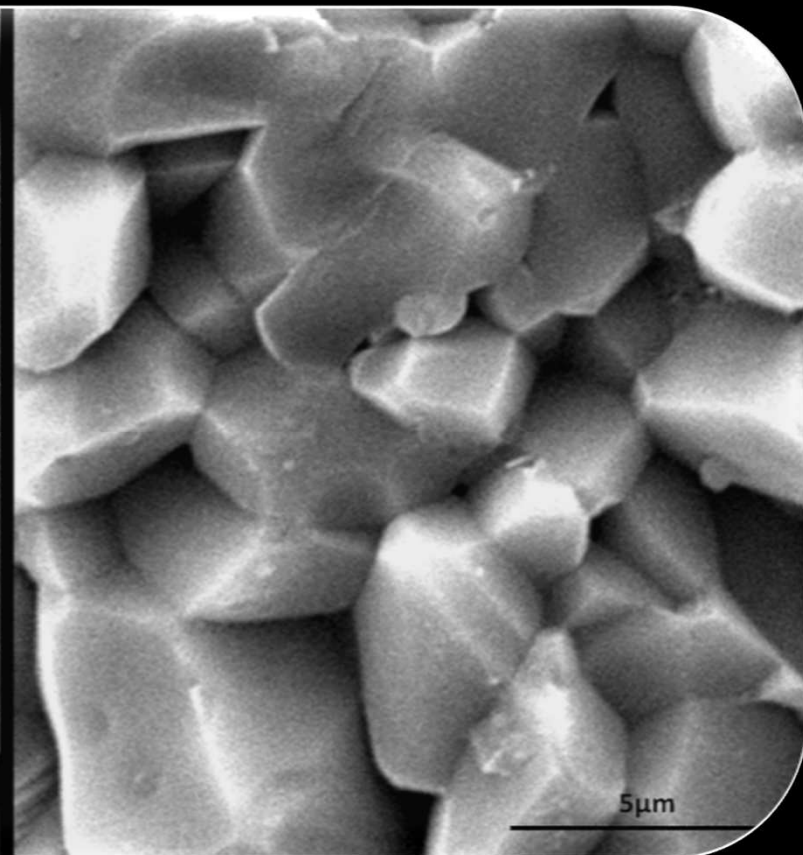
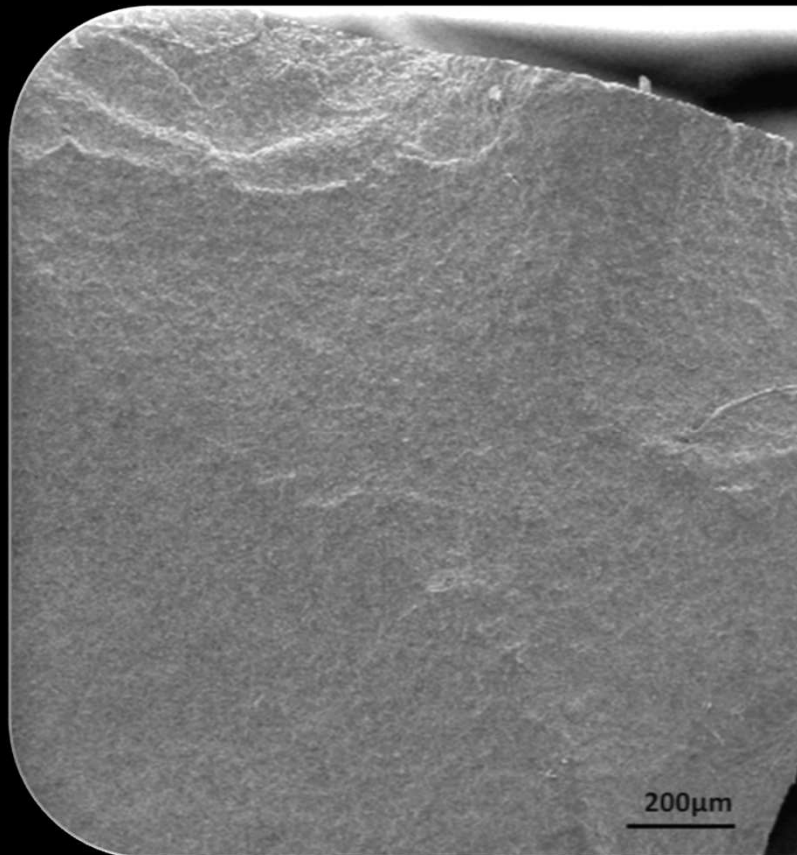
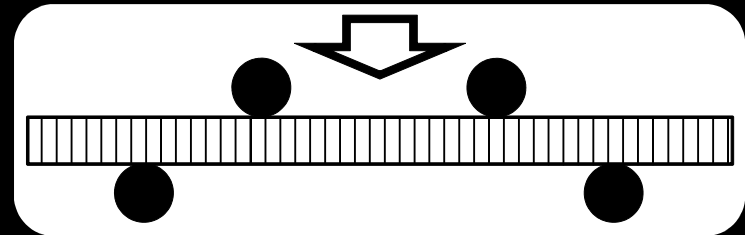
Nominal-actual Comparison

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CEIT biomedical engineering

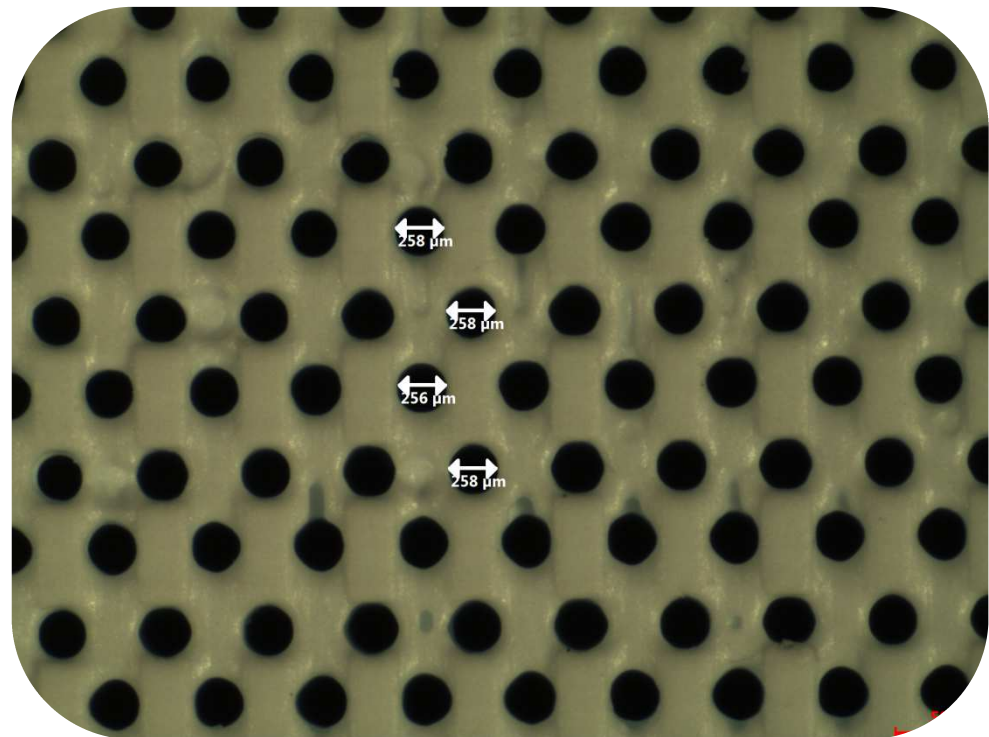


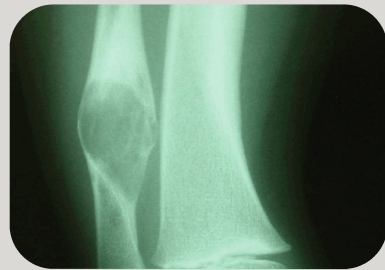
SEM-images of Al_2O_3 -
fractured surface





- β -Tricalcium phosphate
- Bioresorbable
- Customized Implants
- Defined porosity





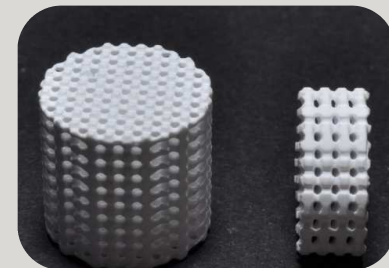
CT-Scan



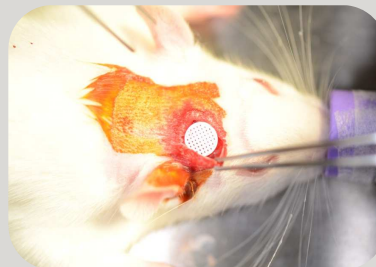
CAD-Model



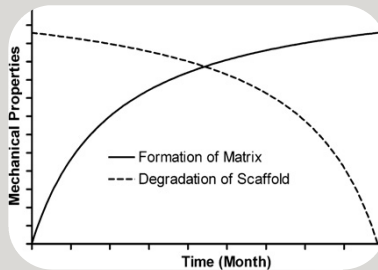
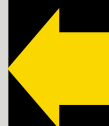
LCM-Process



Scaffolds

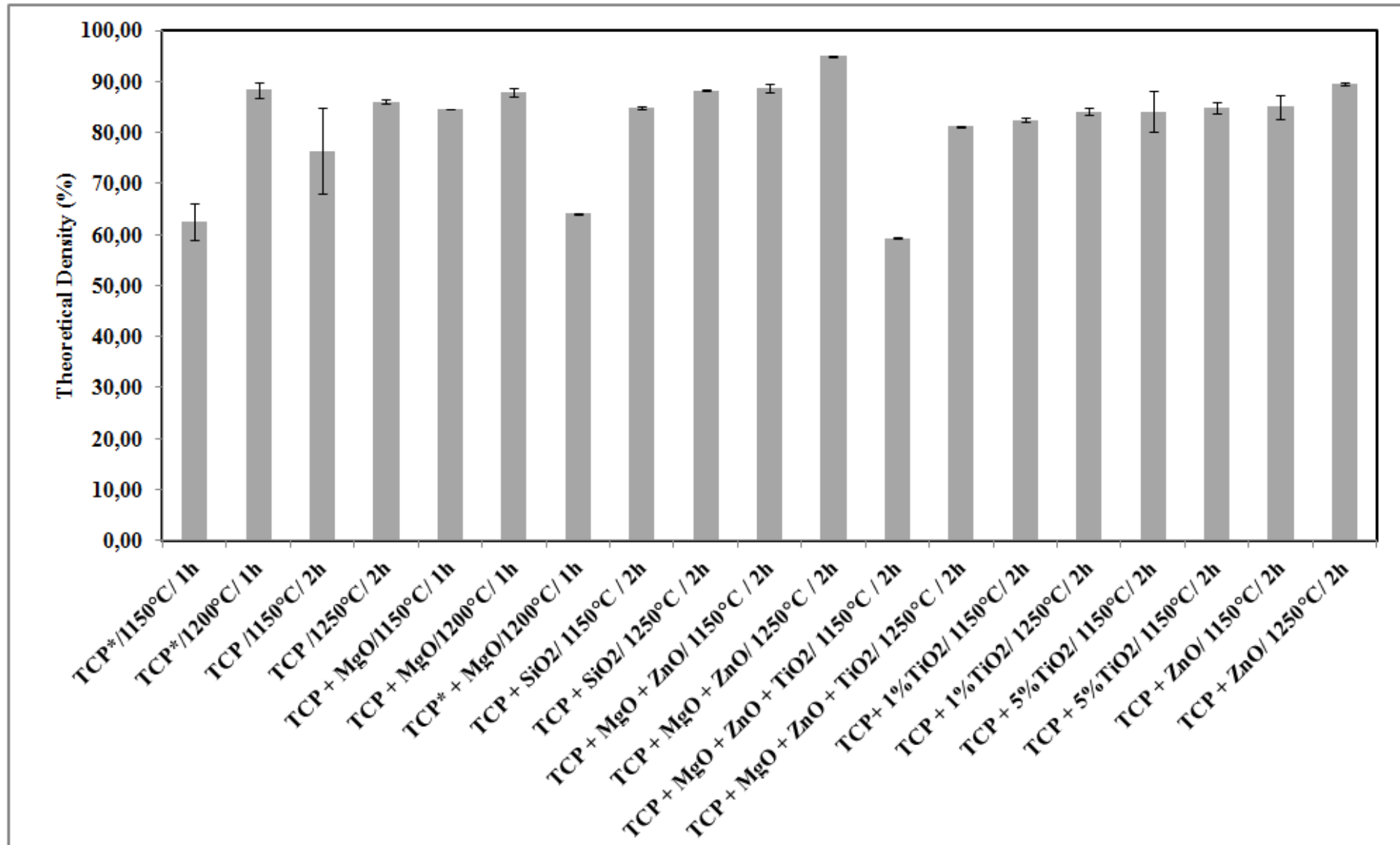


Transplantation

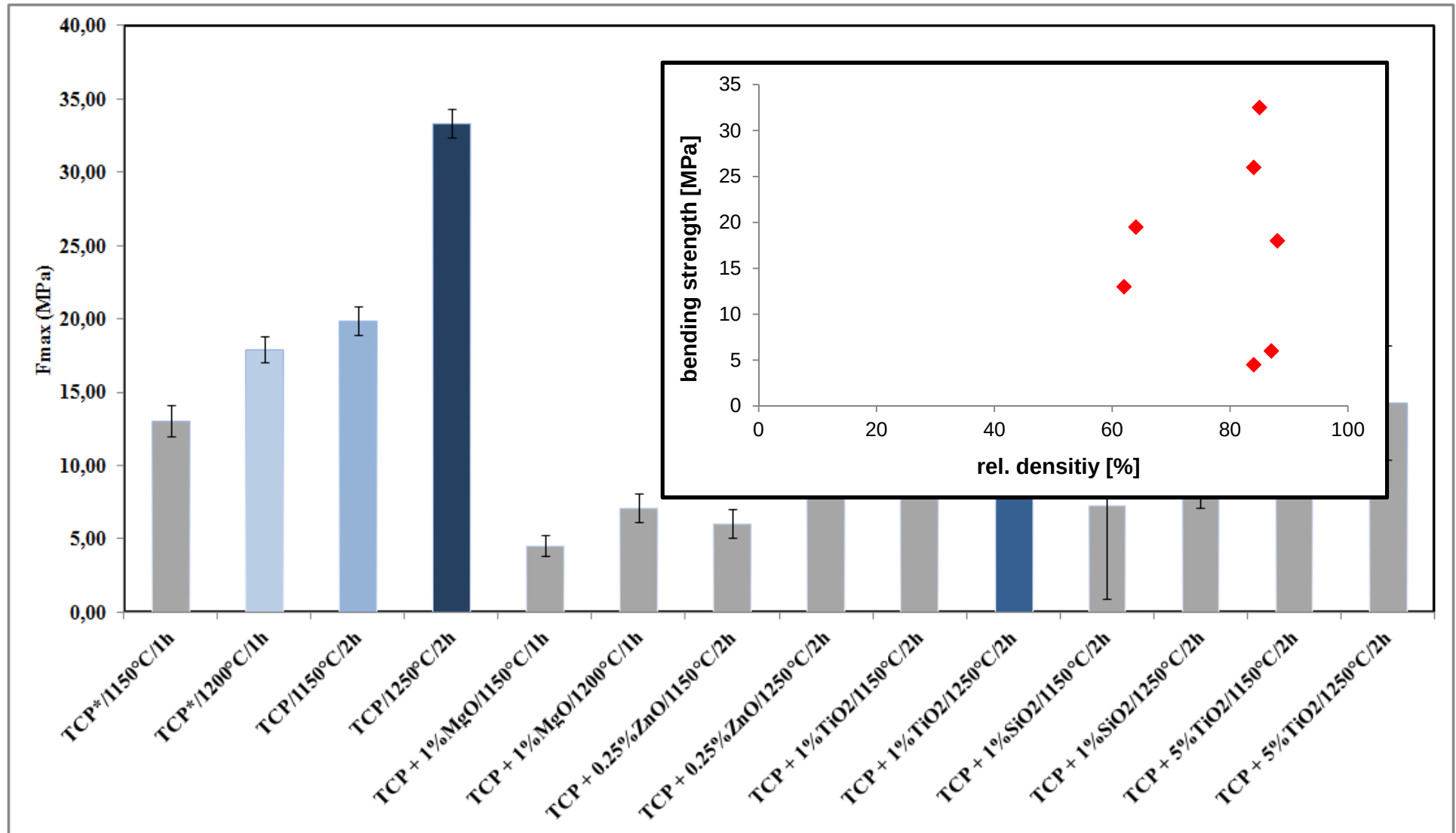


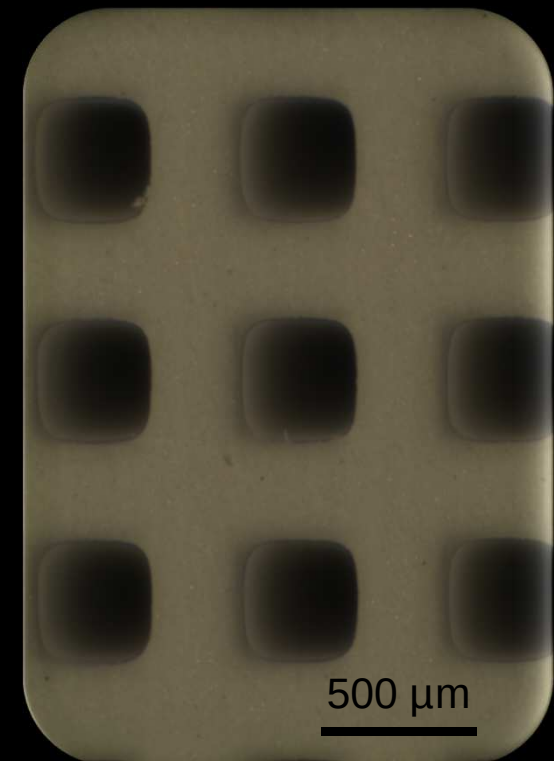
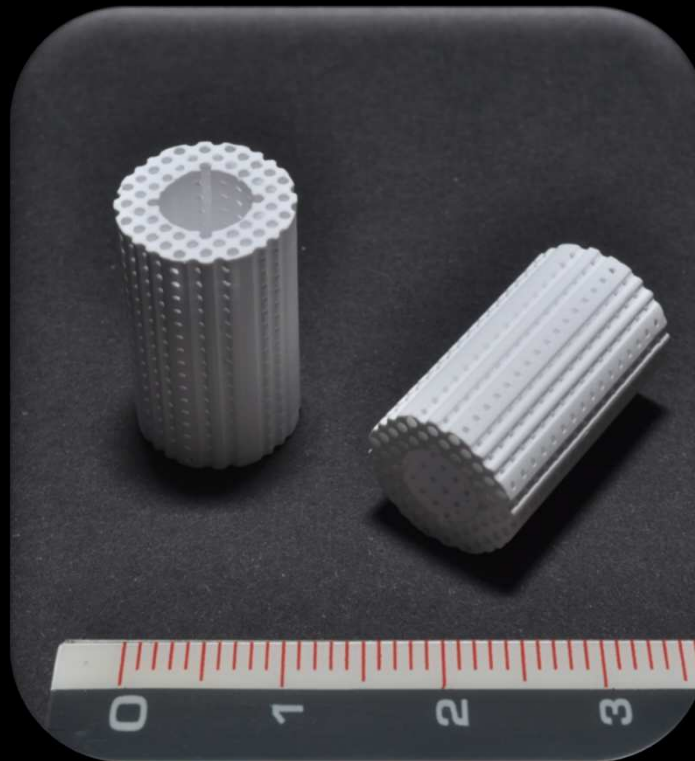
Integration

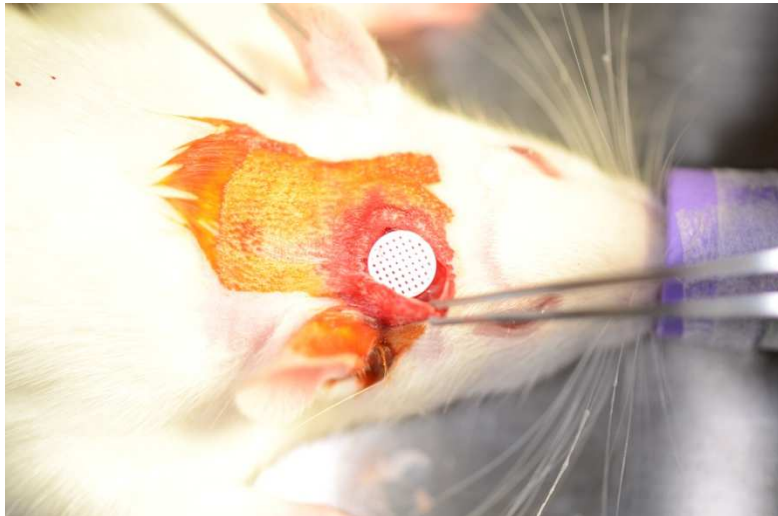
Relative density



Bending strength







Scaffold during implanatation

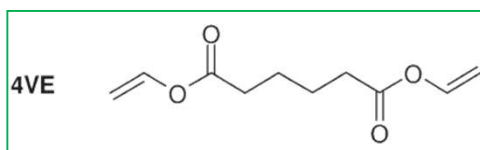
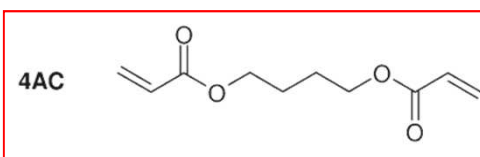
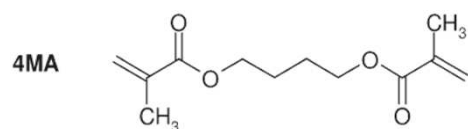


Explantated scaffold after 10 days.
No inflammatory reaction of adjacent tissue.

Studies in bone defects in progress.

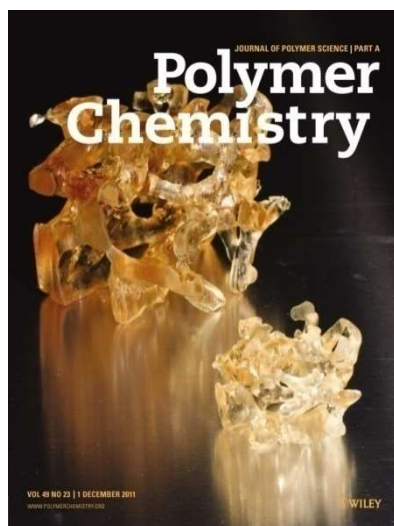
Biodegradable photopolymers

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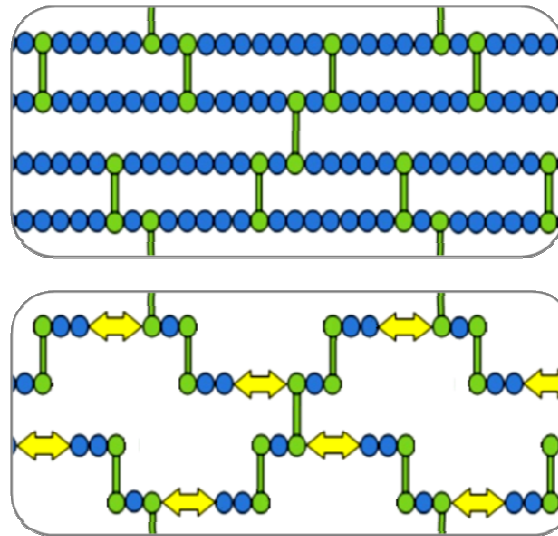
Monomers	Main degradation products	Hydrolysed product of unpolymerized group
Acrylates	 high M_w poly(acrylic acid)	 acrylic acid
Vinyl esters	 poly(vinyl alcohol)	 acetaldehyde $\xrightarrow[\text{in vivo pathway}]{\text{AcDH, } NAD^+ \rightarrow NADH + H^+}$ acetic acid

* AcDH=acetaldehyde dehydrogenase; NADH= nicotinamide adenine dinucleotide



Printing of heart valves

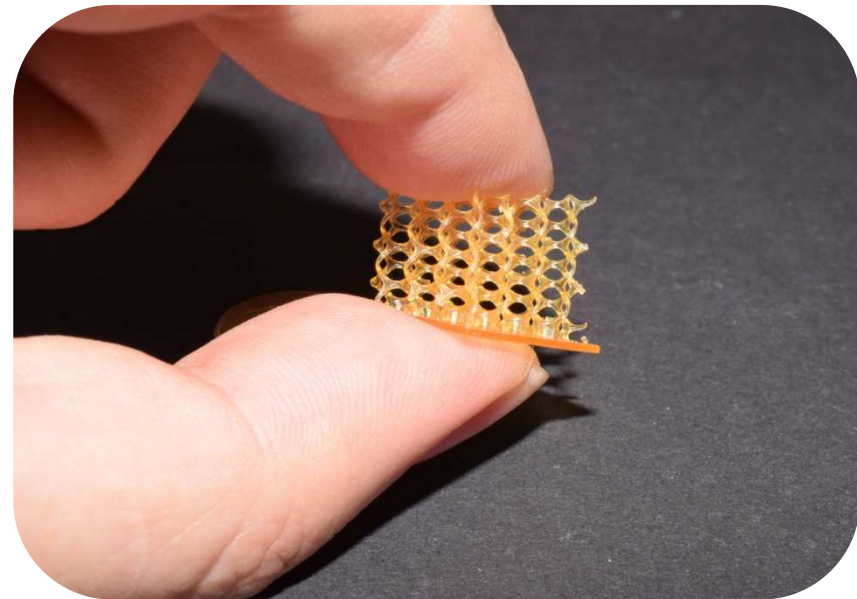
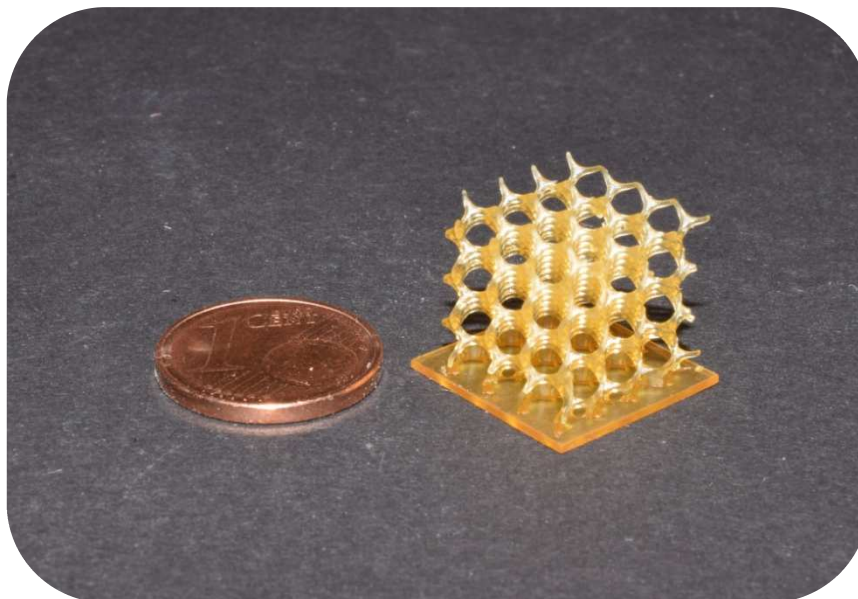
Addition
of thiol




difunctional
vinyl ester

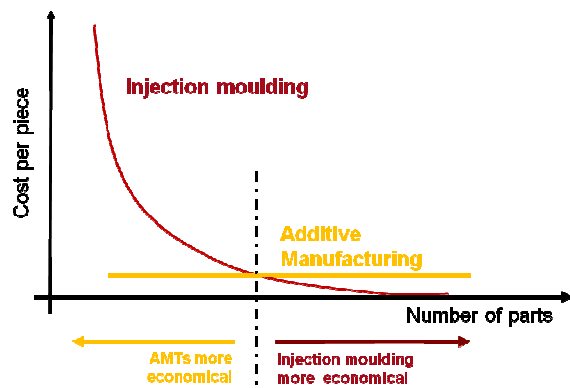
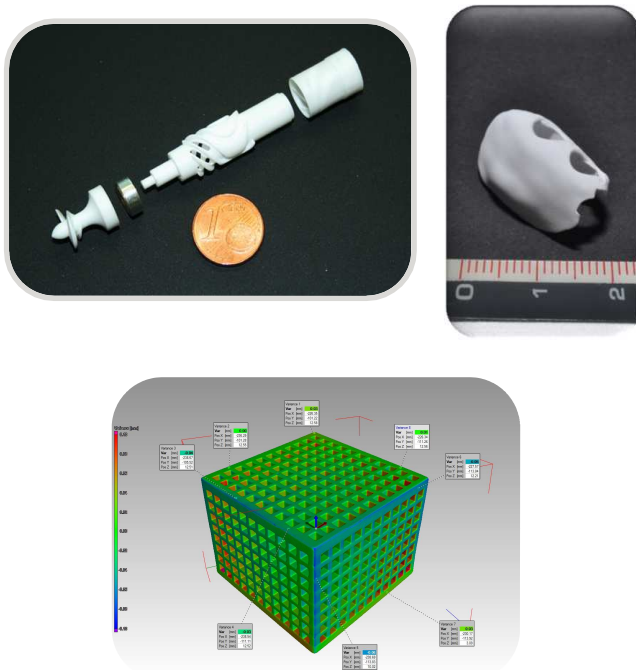

monofunctional
vinyl ester


difunctional
thiol



Conclusion

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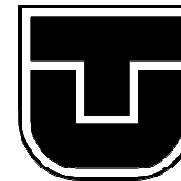
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C. Lüders