CuCD production and novelties

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RHP-Technology

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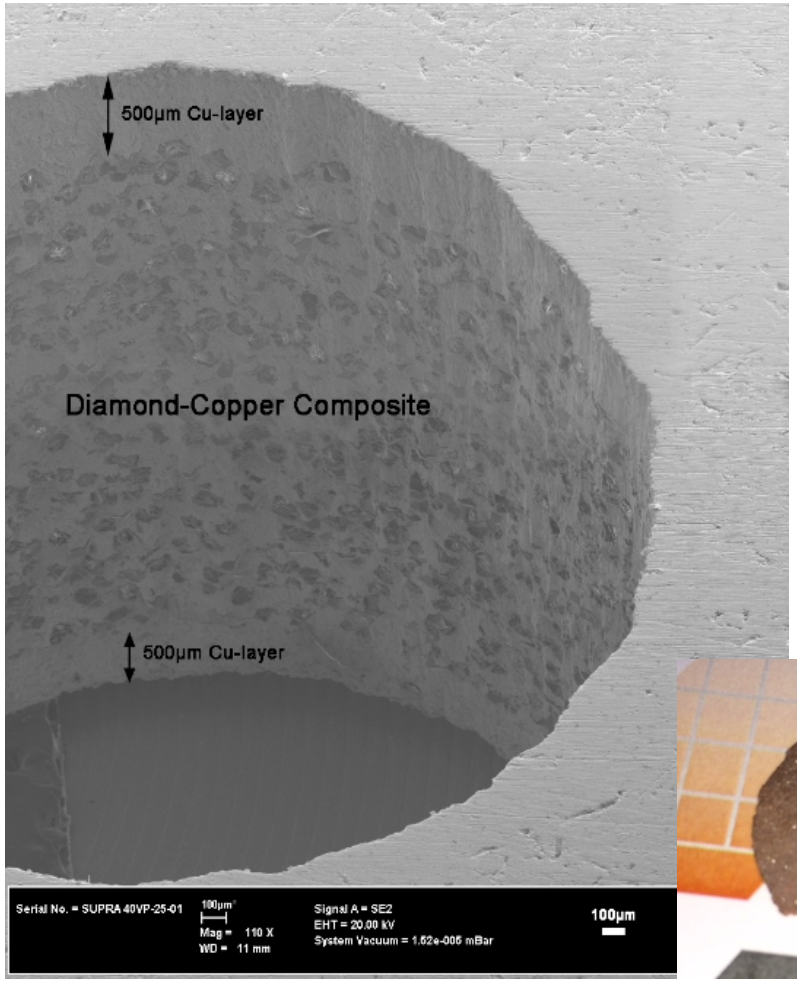
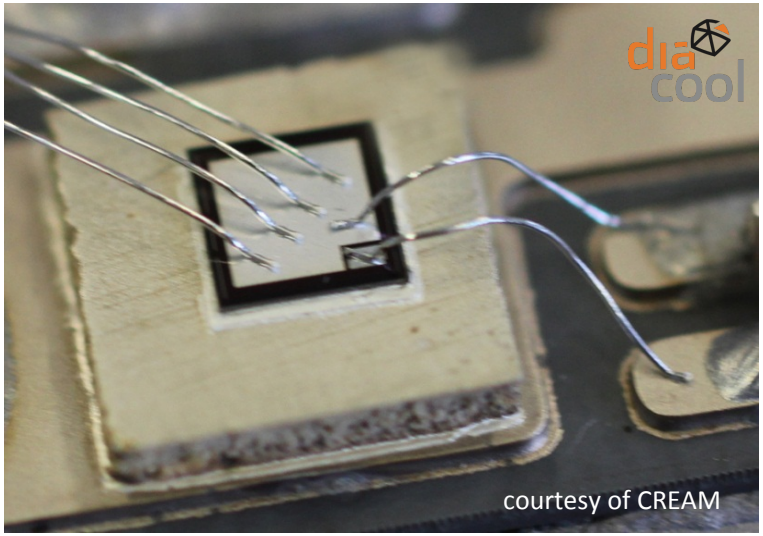
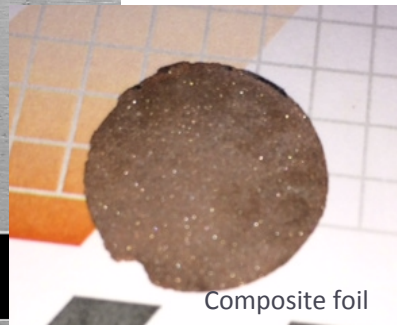
Outline

- Motivation
- Manufacturing technologies – Hot Pressing
- Concepts of Interfaces
- Thermal Cycling challenge
- Geometrical challenges
- Other Concepts
- Summary

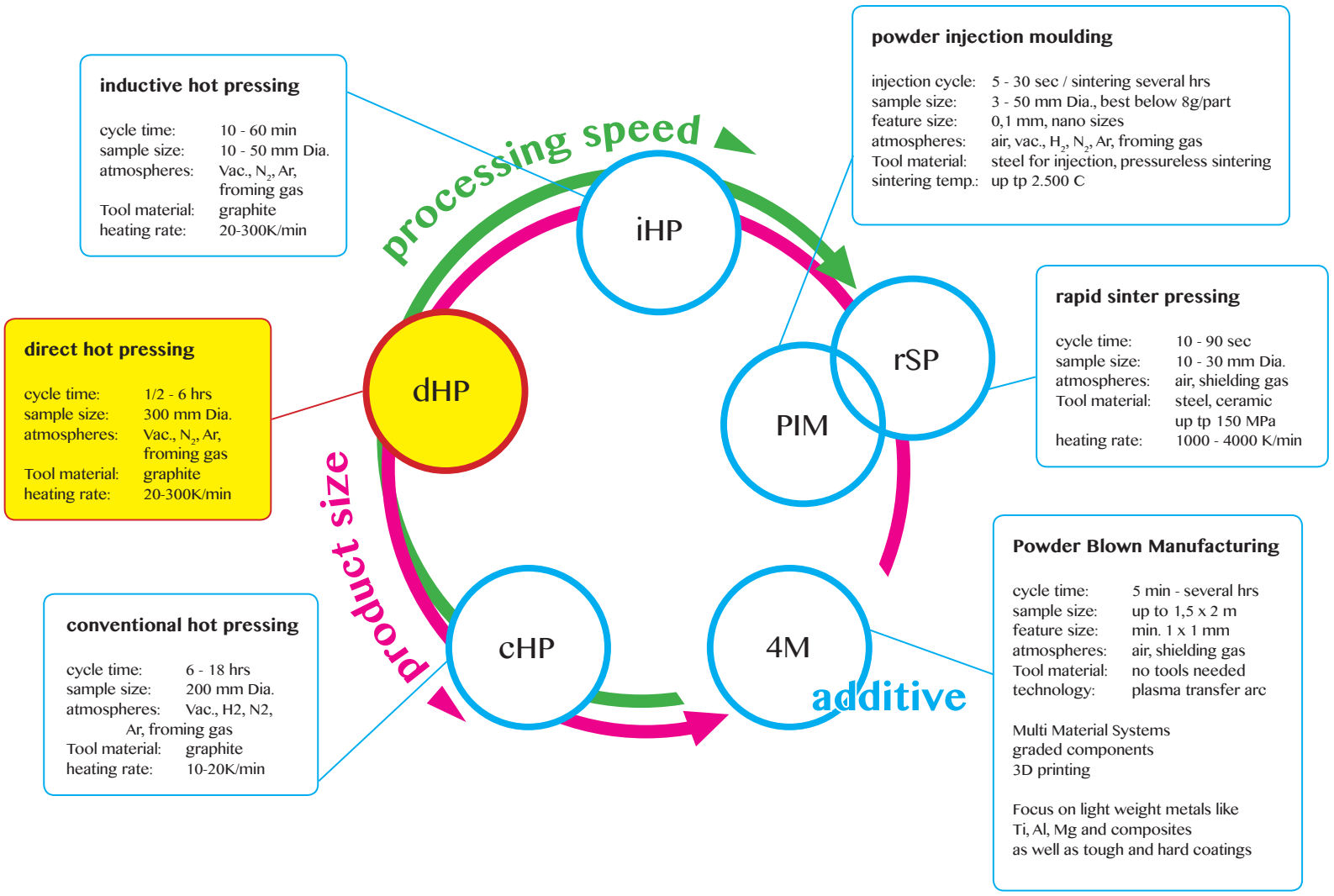
Introductory pictures



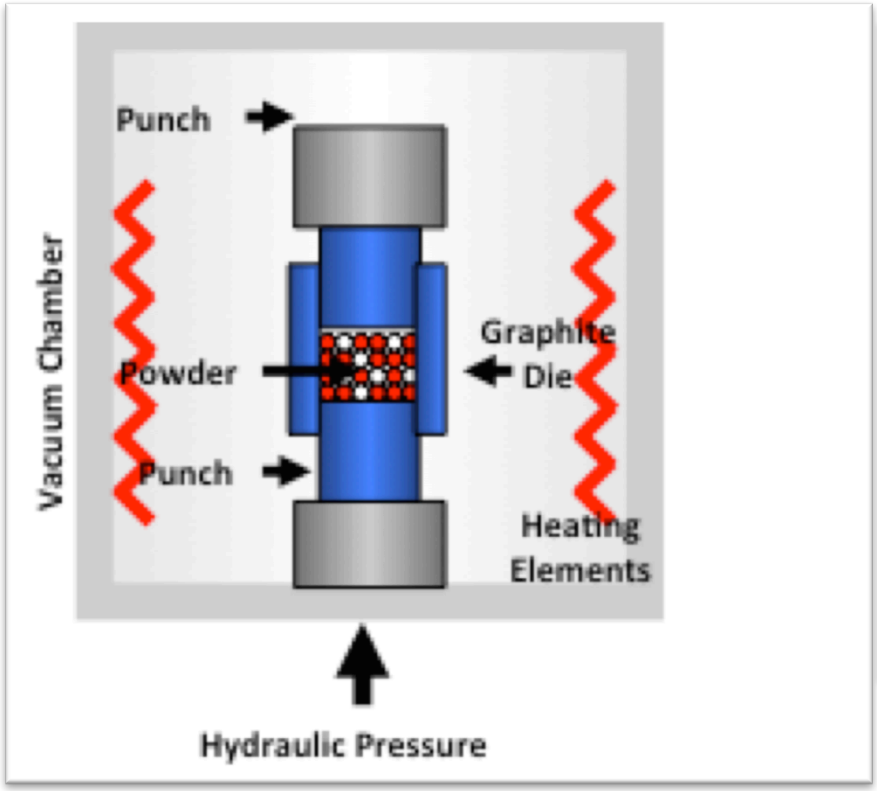


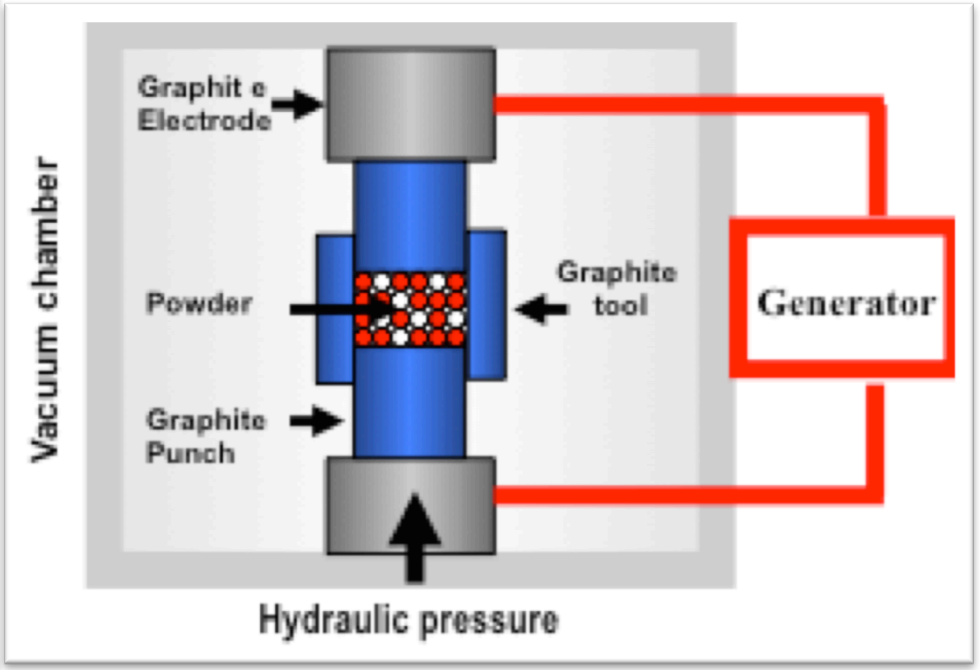


Introductory technologies

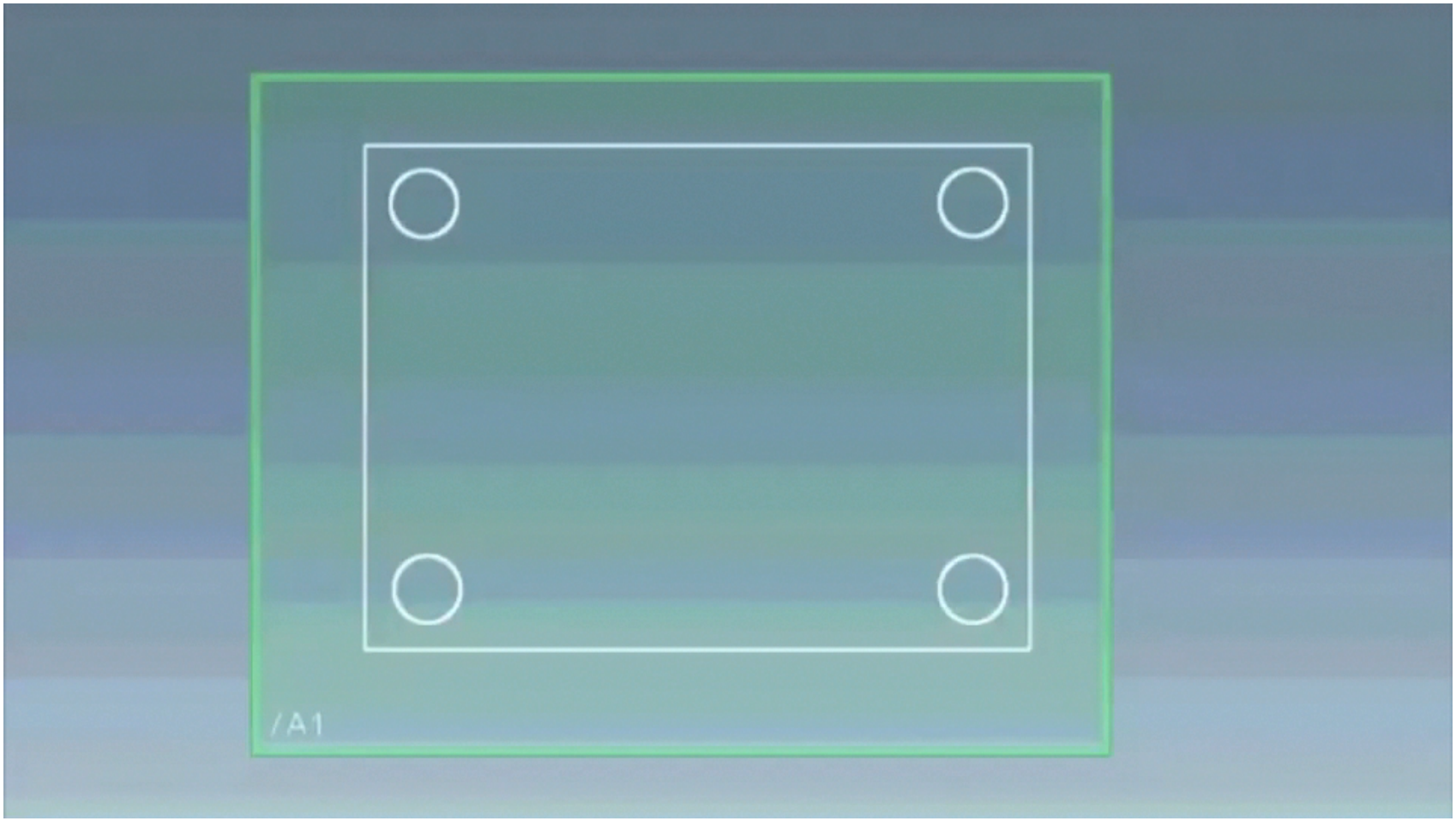


Introductory technologies

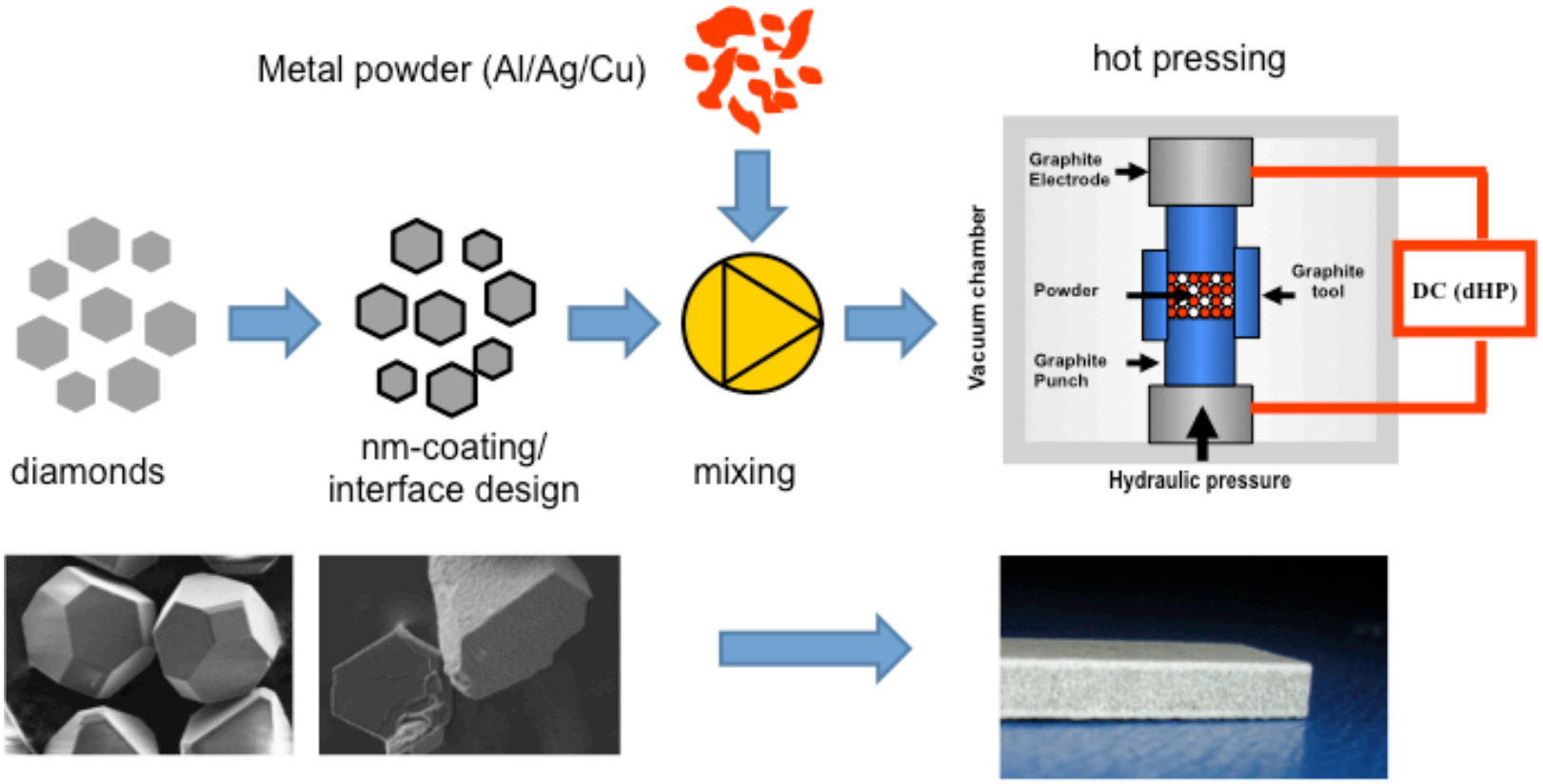




Production movie



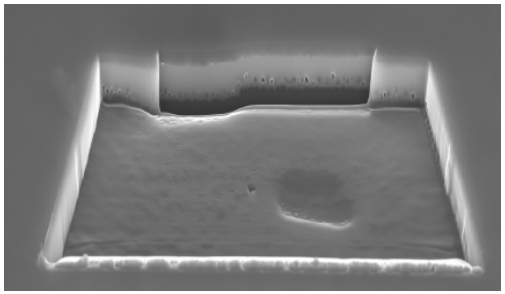
Production sketch

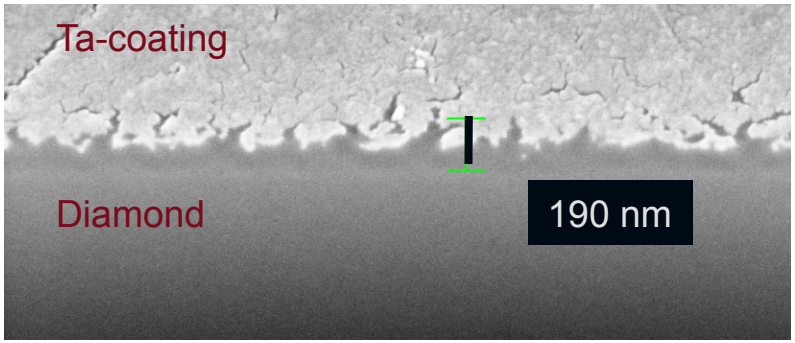


Interface Modifikation

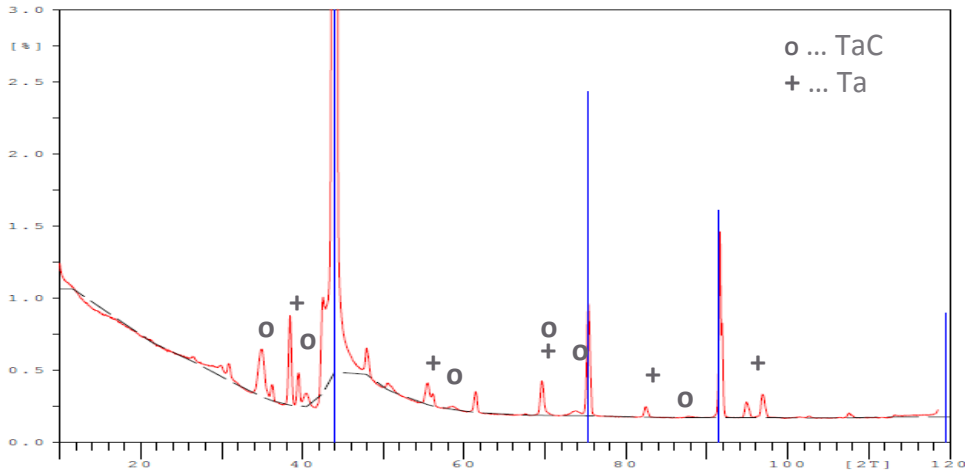
Coated diamond + Cu powder

Diamond + Elemental powder + Cu powder



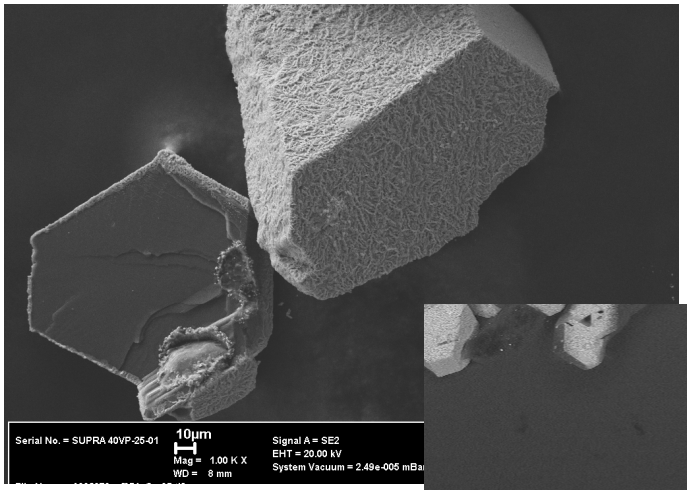


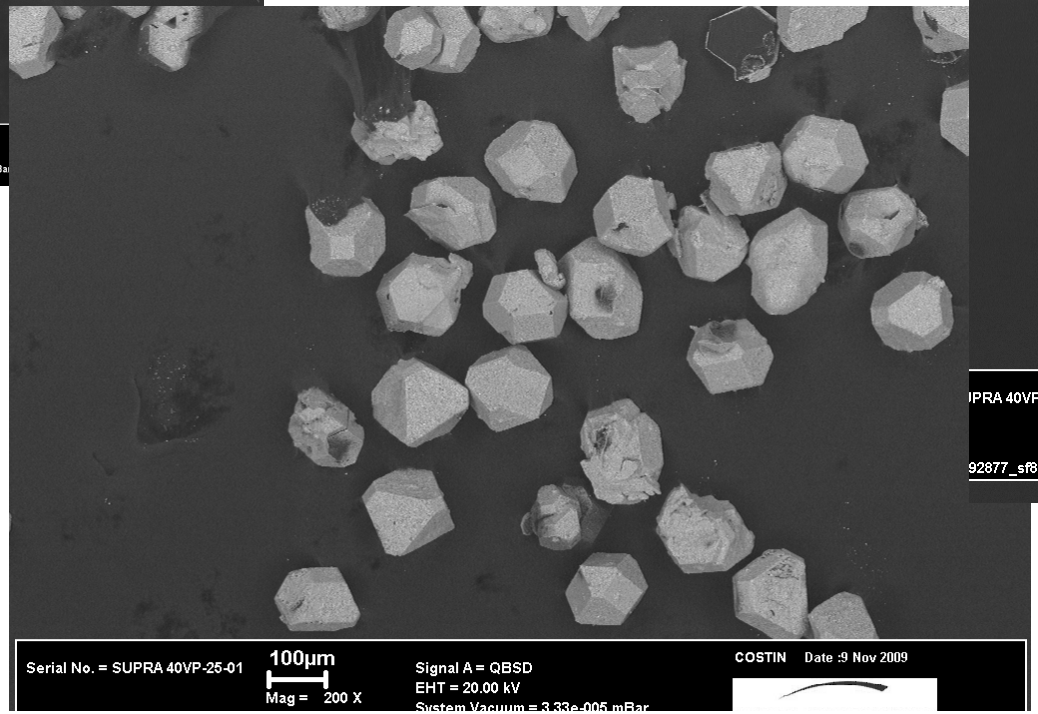
XRD Analysis shows Carbide phases (TaC) in the sample

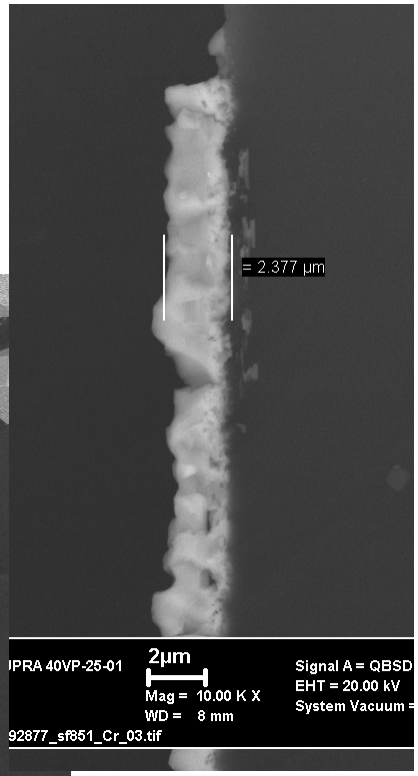


Compared to Ta, TaC exhibits smaller crystallite grains.

Coating of diamonds

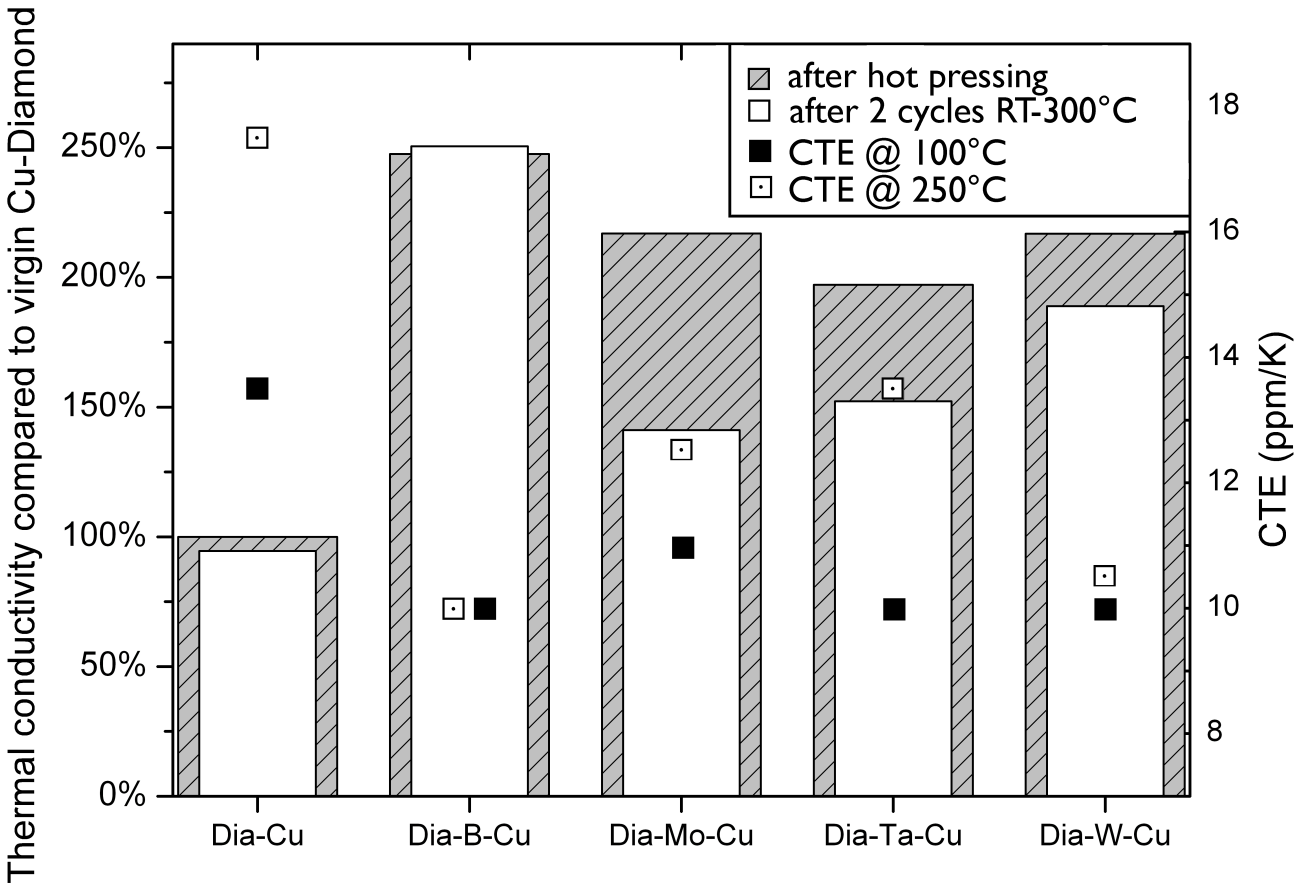




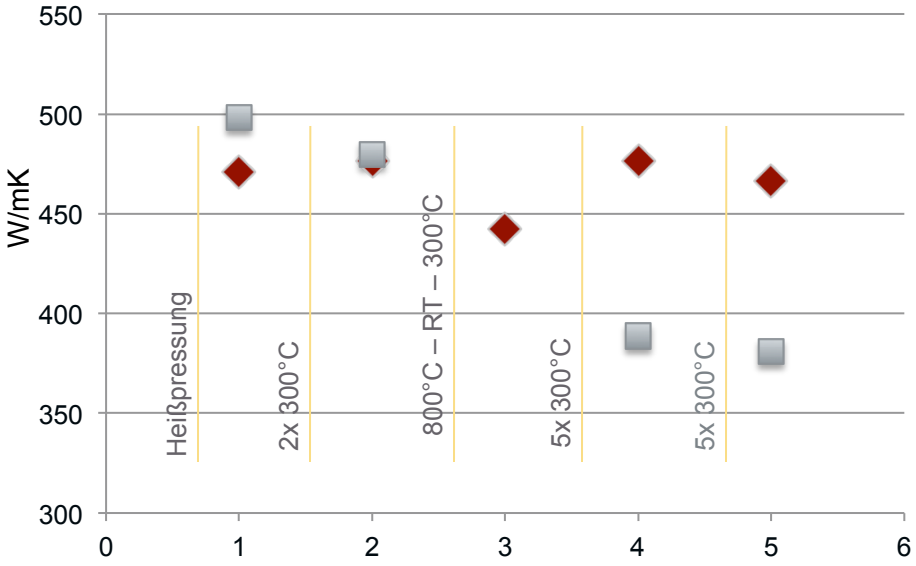


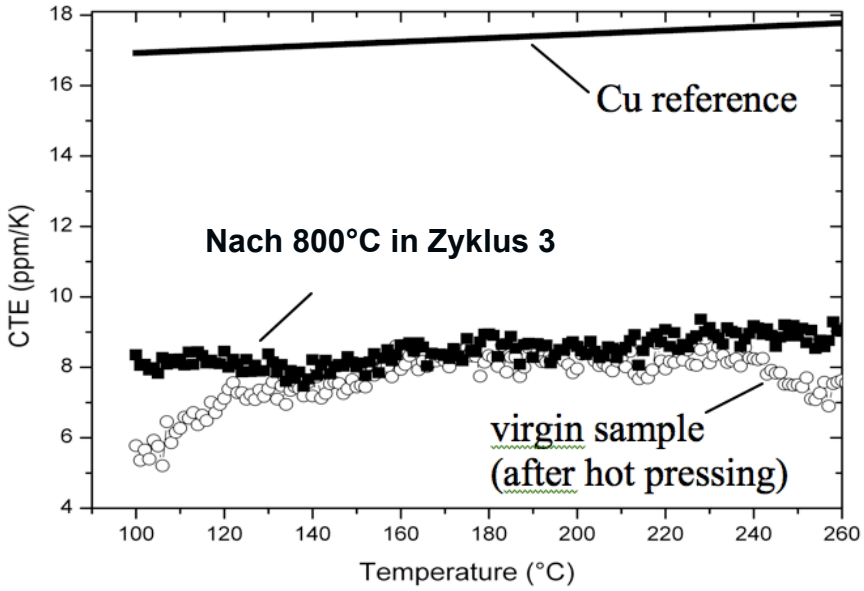
Cycling behavior

50 vol% Diamonds – „coated“



@ high temperatures





- 1: nach HP
- 2: nach 2x RT-300°C
- 3: nach zus. 800°C-RT-300°C
- 4: nach zus. 5x RT-300°C
- 5: nach zus. 5x RT-300°C

Thermal influences

- 5nm Niob – Kupfer – Schicht

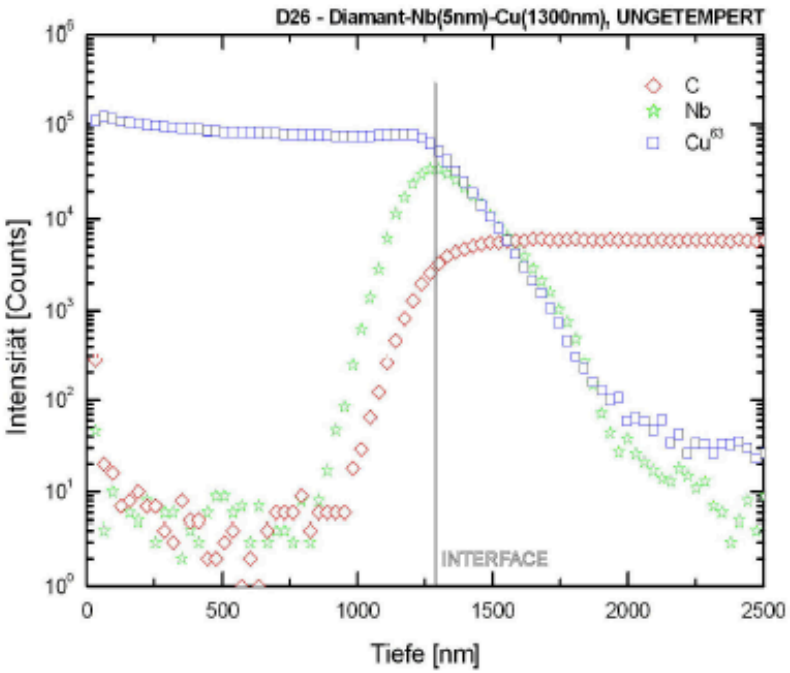


Abb. 67: D26 – UNGETEMPERT

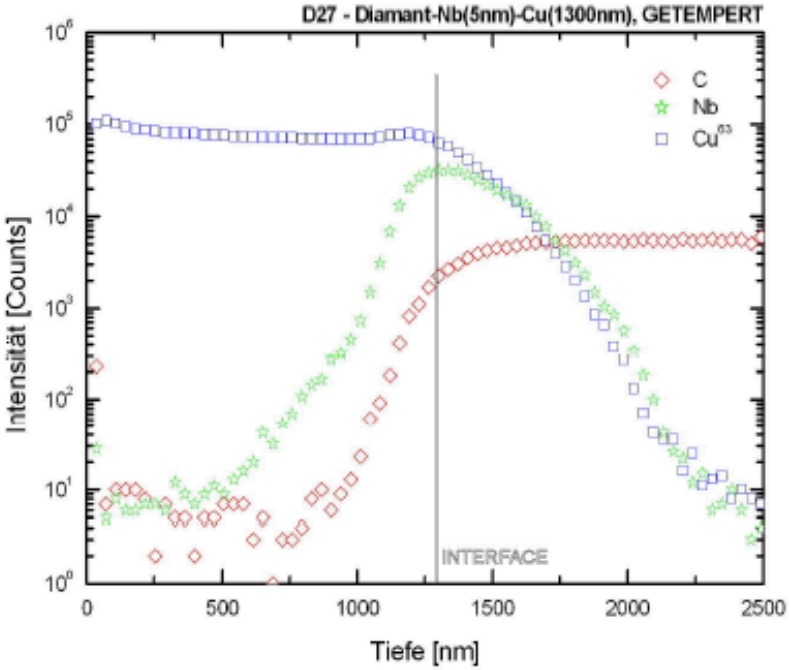
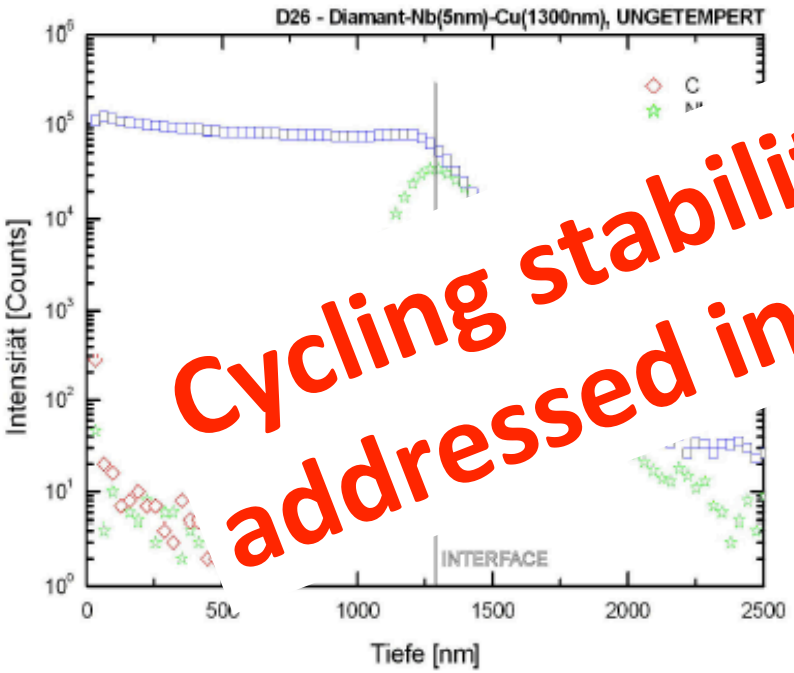
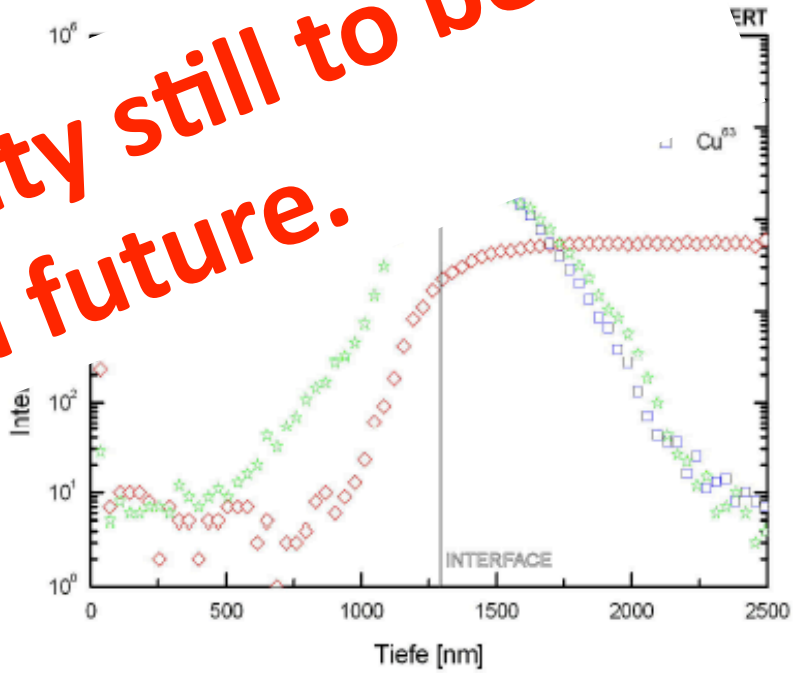


Abb. 68: D27 – GETEMPERT

Thermal influences

- 5nm Niob – Kupfer – Schicht



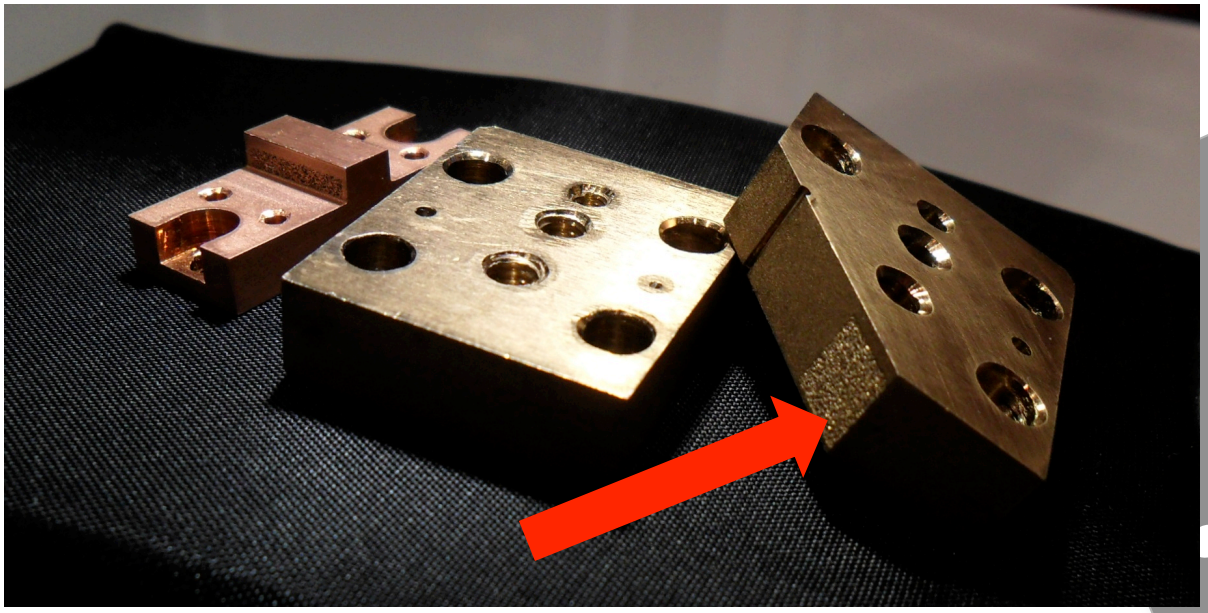


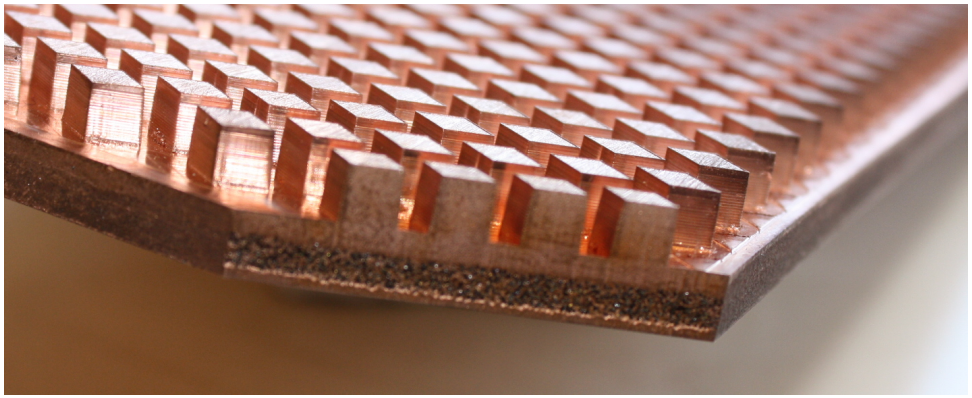
Cycling stability still to be addressed in future.

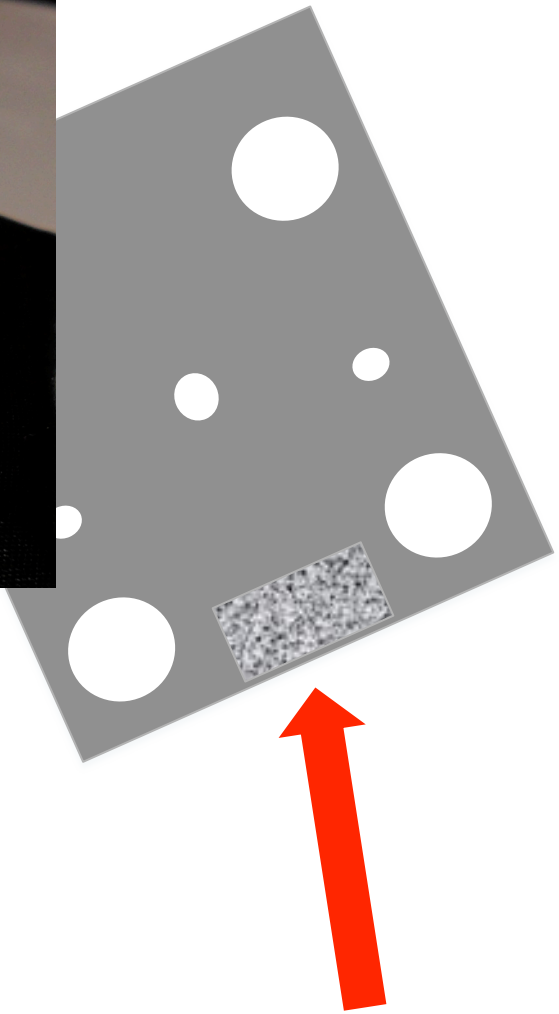
Abb. 67: D26 – UNGETEMPERT

Abb. 68: D27 – GETEMPERT

Geometrical challenges I



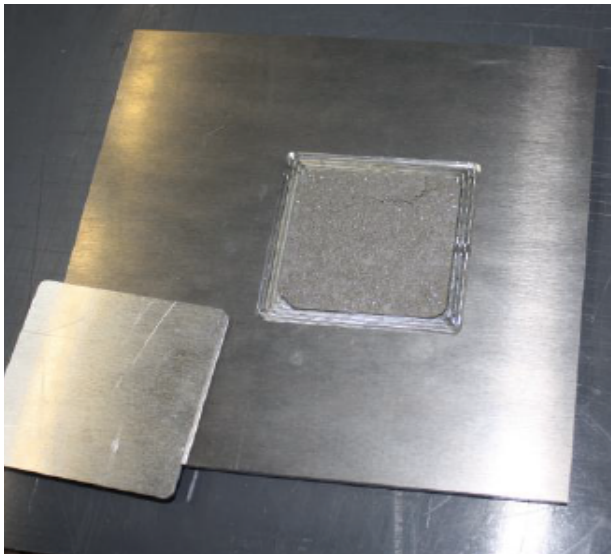


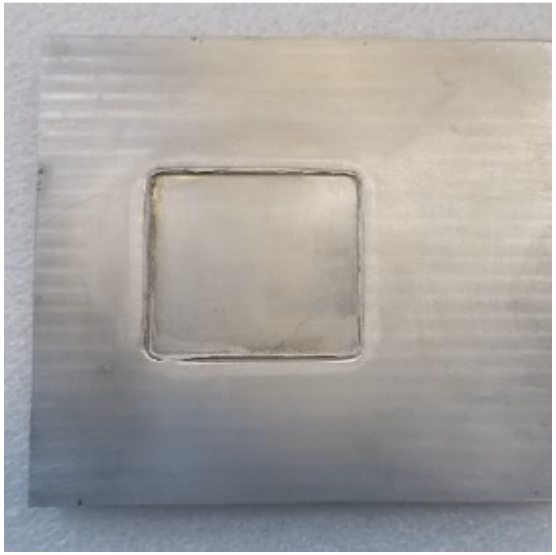


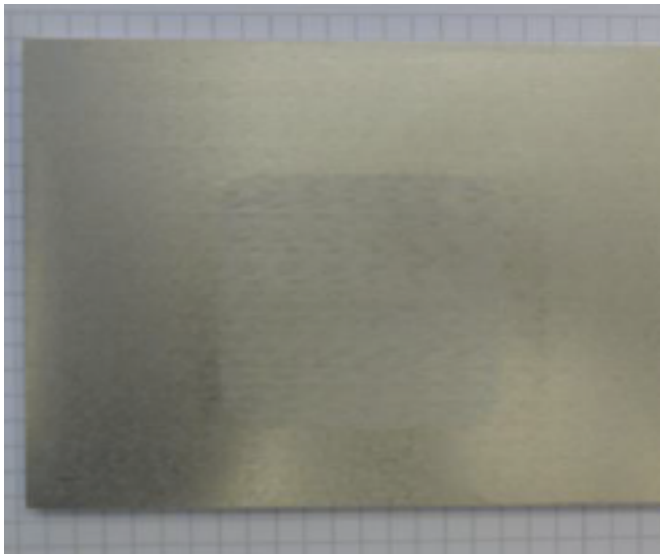
Geometrical challenges II

Aluminium-Diamond

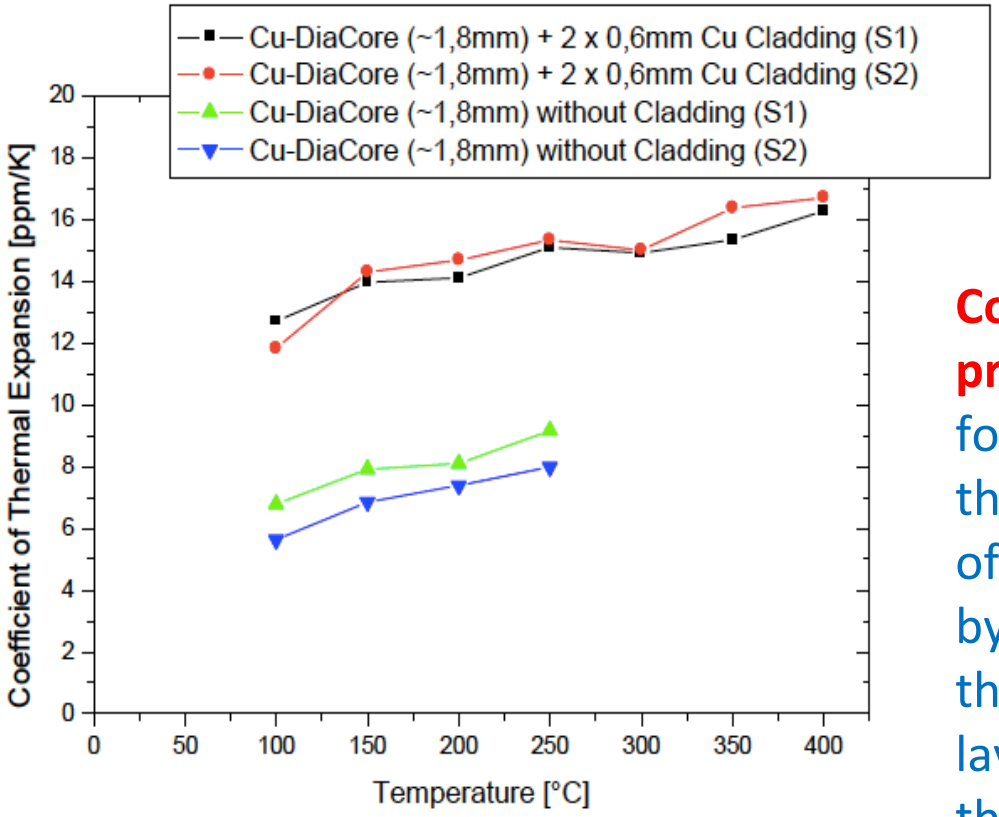
Local Inserts (see below 50x50mm) can be directly implemented into a pure metal base plate (e.g. Al).







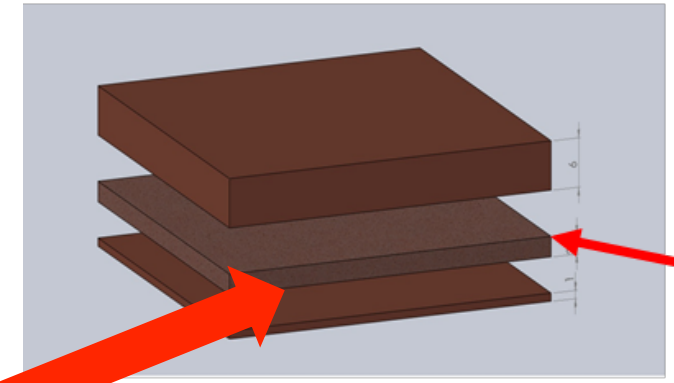
Geometrical challenges III

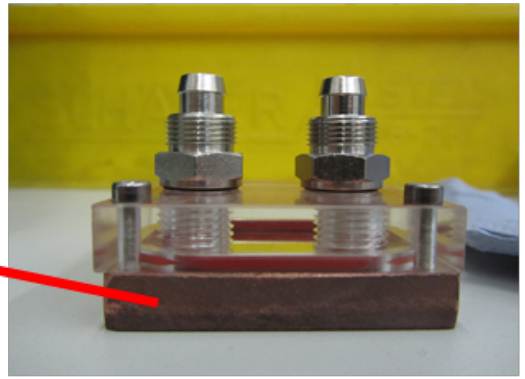


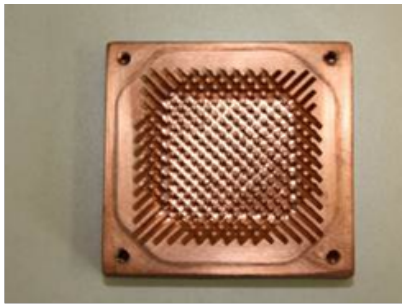
Copper-Diamond (rapid hot pressed):

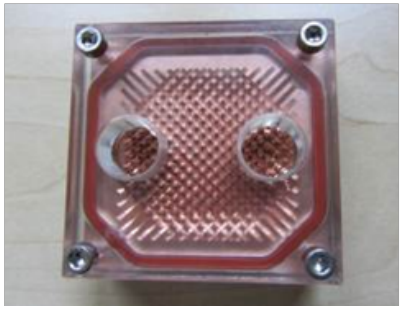
for thin cladding layers compared to the composite core, the coefficient of thermal expansion is dominated by the one of the core. Obviously this is no longer true, when cladding layer and core have similar thicknesses.

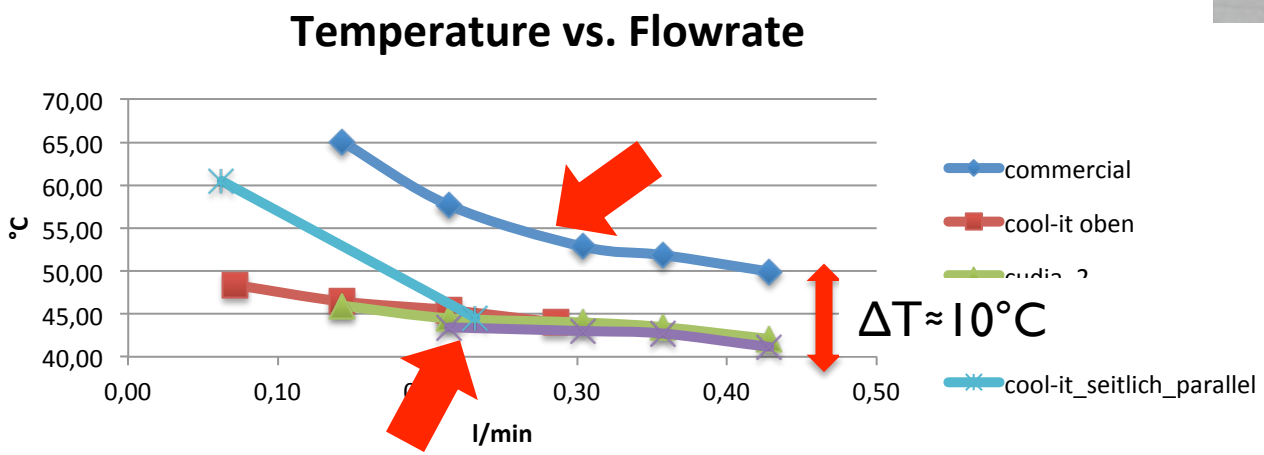
Other concepts I







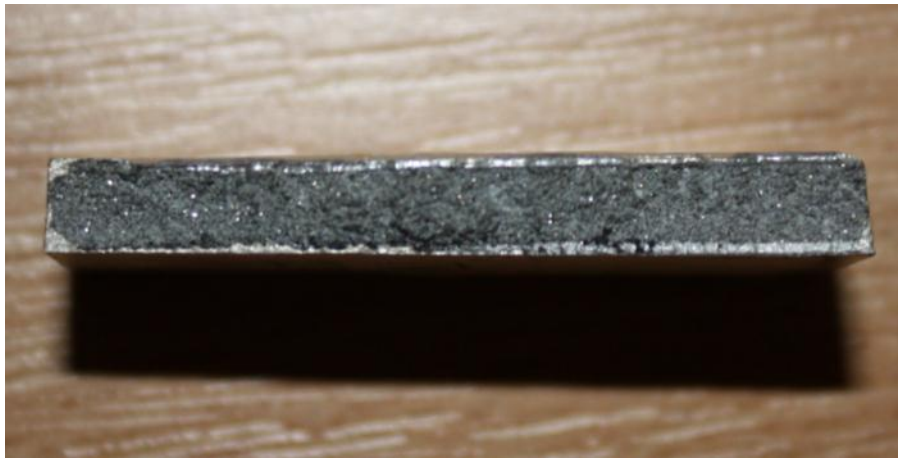




Oxide layer on Al-Dia

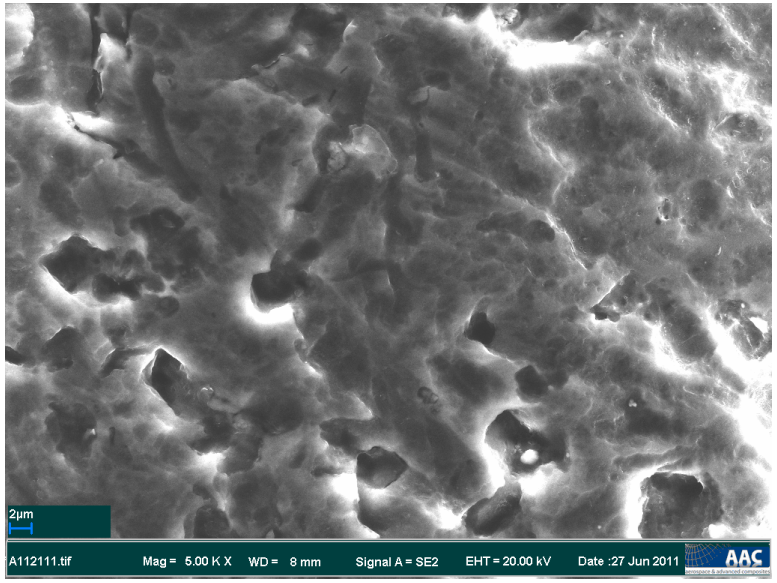
Electrical insulation by oxide layer

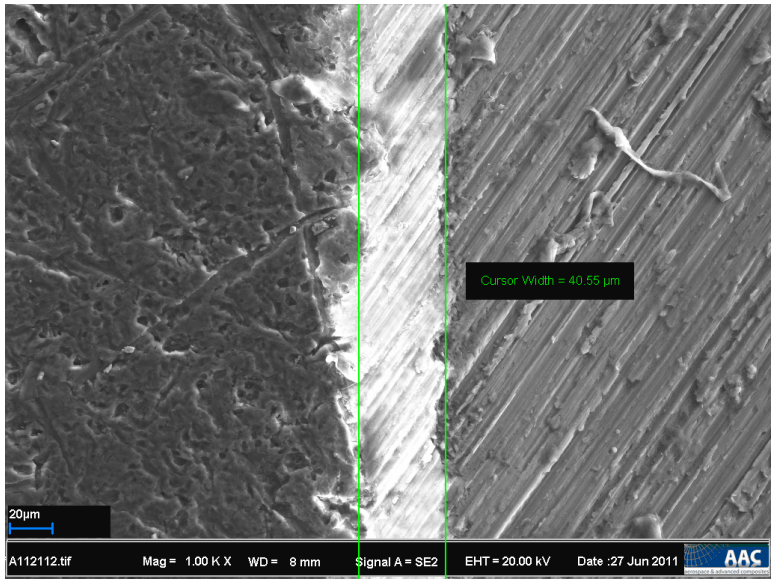
- Layer was formed on the Al surface
- Silverpaste was attached to test electrical insulation
- After two days el. conductivity was observed.



Oxide insulation II

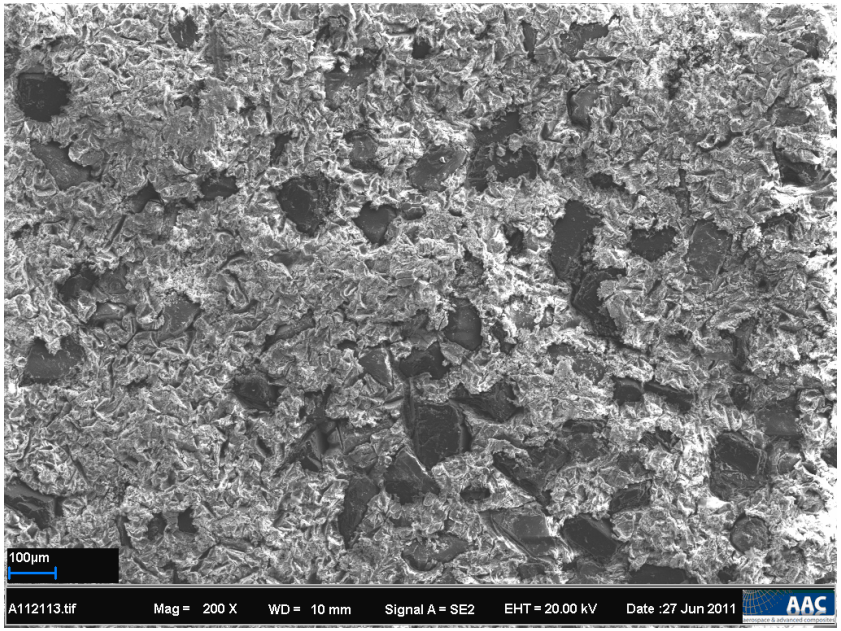
- Al2O3 layer was found to be porous structure
- Thickness was approx. 40µm

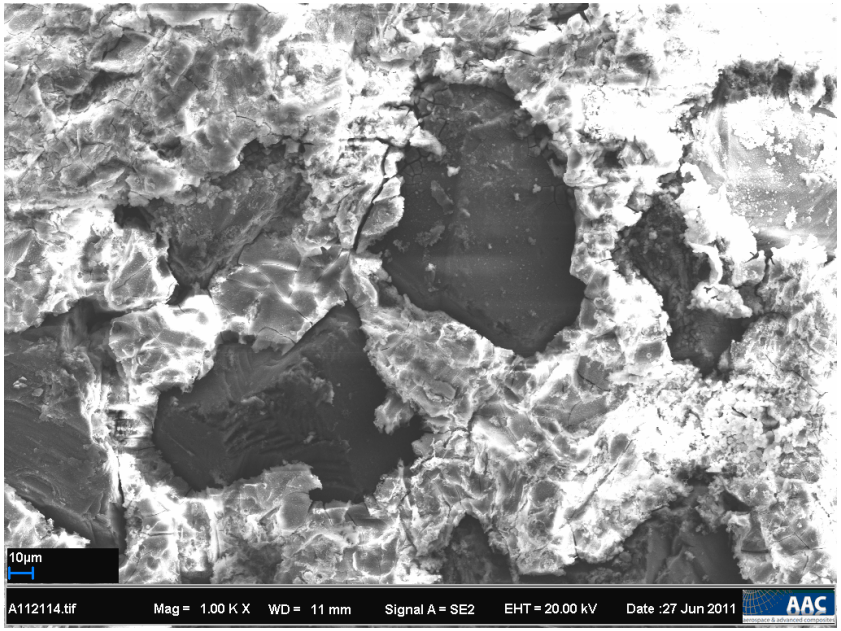




Oxide insulation III

- Areas with diamonds sticking out through the surface were observed to show similar behavior like the pure Aluminium/Alumina layer





Summary

Manufacturing routes by hot pressing

- Interface between diamond and matrix by insitu formation during hot compaction or by precoating the particles
- Thermal cycling stability needs to be addressed in more detail
- Geometrical tolerances to be addressed by an engineering approach, cutting, grinding and polishing of diamond containing sections is very tricky, time consuming and expensive, not always giving satisfying results.

Other concepts:

- Experience and results may help to understand the challenges and find solutions for them.
- Besides physical properties, applications can throw up additional demands e.g. machining or surface finish

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Thank you for your attention.