La structuration laser du saphir : applications et défis

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BCI

Contents

- W. Blösch AG – short presentation
- Physical basics
- Material challenges
- Surface matting / deep engraving
- Combination with decorative / functional coatings
- Conclusions

W. Blösch AG

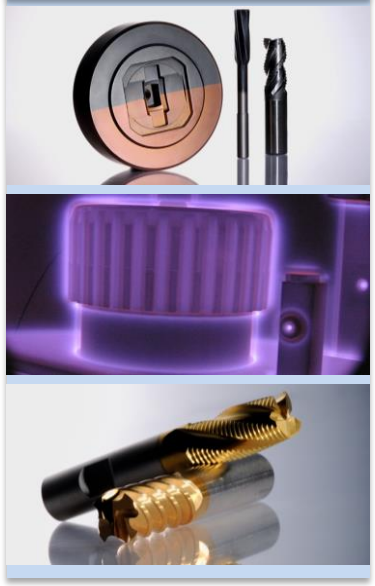
BCI

Board

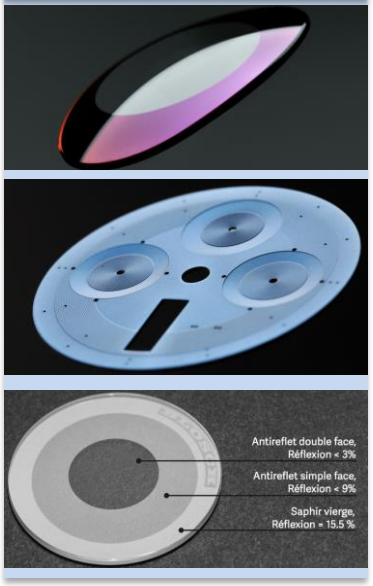
Services

Systems

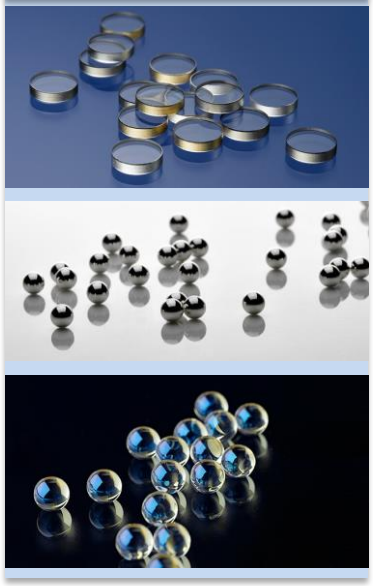
Division MEM



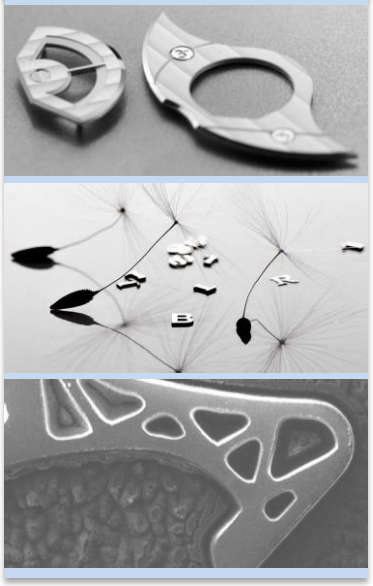
Division UI



Division IP

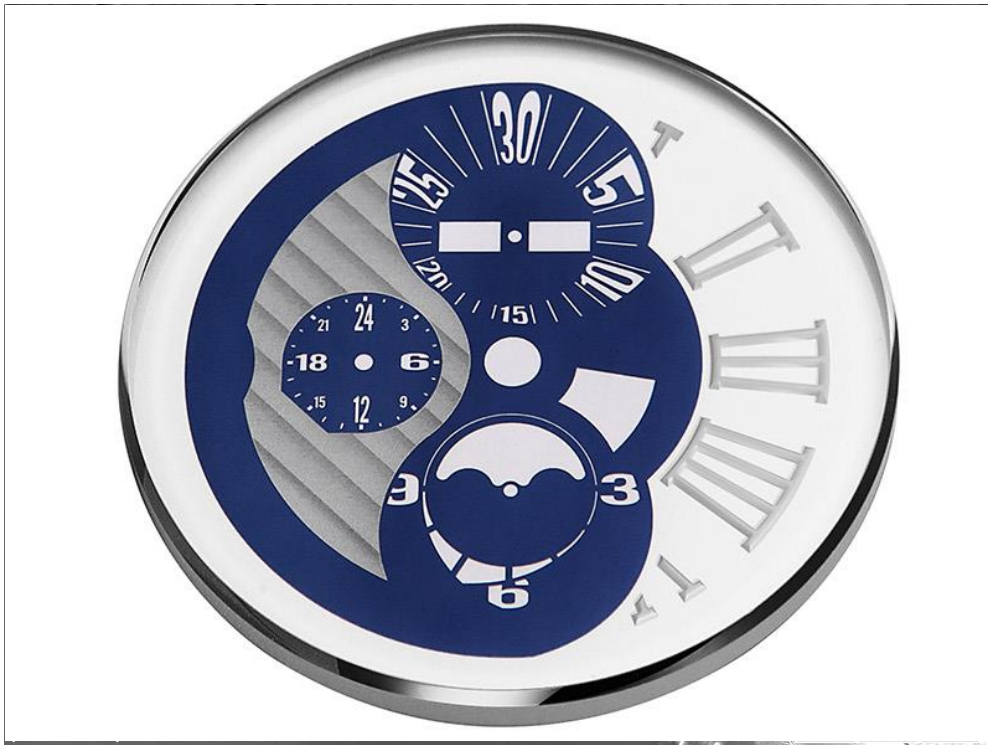


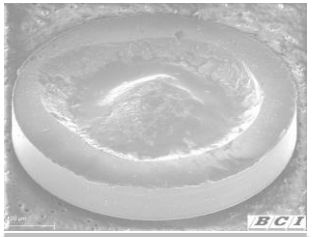
Division CIH

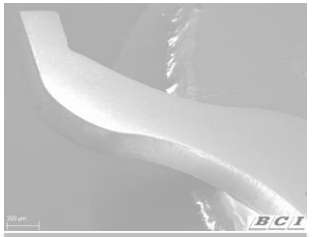


Laser @ Blösch

- welding
- toolmaking
- pad printing *clichés*
- fine cutting
- sapphire structuring

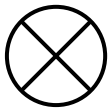






Physical Basics

Laser
- wavelength
- pulse duration
- fluence
- …



Material
- surface reflectivity
- thermal properties
- internal stresses
- …

Process
- ablation threshold
- ablation rate
- affected zone
- …

Material Challenges

Fabrication

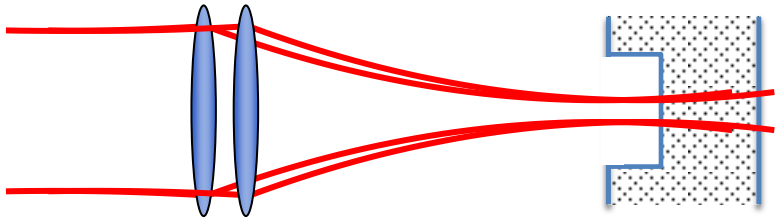
- crystal growing may yield:
  - point defects
  - dislocations
  - substructure grains

  (depending on growth type)
- grinding, lapping, polishing:
  - subsurface affected layer
  - mechanical stresses
  - microcracks
- thermal treatment:
  - should improve surface / volume properties
  - may reduce internal stresses

(Dobrovinskaya, Elena R. *Sapphire*. New York: Springer, 2009)

Transparency

- machining tool passes through



- nonlinear effects

	n_2 (10^{-15} cm^2/W)
sapphire	0.3
diamond	1.3
glass	0.3

- unwanted yield:
  - surface / volume cracks
  - back side damages

(Boyd, Robert W. *Nonlinear Optics*. San Diego: Elsevier, 2003)

Matting & Greyscale

- surface layer texturing
- different shades
- sharp field edges
- precisely defined grey tone

Engraving

- depths up to 0.5 mm
- sharp edges
- fairly steep walls
- translucid bottoms

- cracks (thermal annealing)
- backside damages (thin pieces)

Texturing & PVD Coating

- surface layer texturing
- mat metallisation
- precisely defined colour tone

PVD Coating & Texturing

- sharp field edges
- colour gradient
- sapphire transparency

- sapphire surface damages

AR Coating & Texturing

- anti-counterfeiting
- sapphire transparency
- sapphire surface damages

Conclusions

- enormous design opportunities
- mat metallisation
- anti-counterfeiting
- volume / surface damages

☑ thermal annealing
☑ piece pedigree