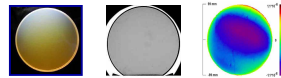


Mirror Blanks for Extremely Large Telescopes

Peter Hartmann, Thorsten Döhring, SCHOTT AG Mainz

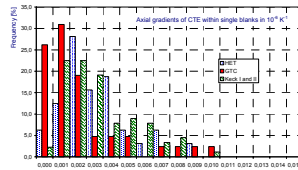
Molten like optical glass, Zerodur is

- isotropic, no rings, no layers
- flawless, seamless
- highly polishable
- homogeneous throughout the total volume
- highly reproducible in properties and quality
- thoroughly inspectable



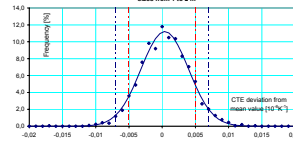
Zerodur 200 mm disk free from bubbles and inclusions and striae with high homogeneity

Axial CTE homogeneity of mirror segments for the HET, KECK and GRANTECAN telescopes



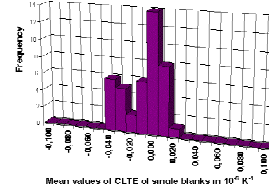
The axial CTE homogeneity values are not significantly above the measurement accuracy of $0.0025 \cdot 10^{-6} \text{ K}^{-1}$ (1σ) for a single measurement.

CTE homogeneity: Variation around segment mean values set to zero for all mirror segments for the HET, KECK and GRANTECAN telescopes



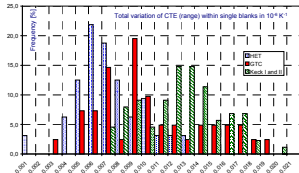
The CTE values do not vary much more than expected merely due to statistical measurement scattering.

CTE absolute values of the 42 GRANTECAN mirror blanks



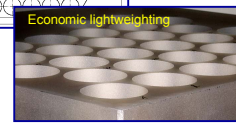
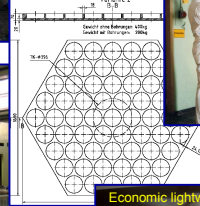
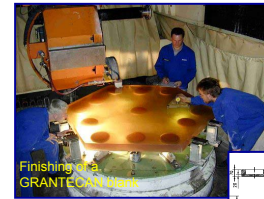
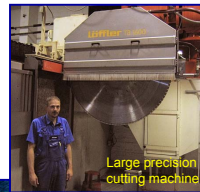
The CTE values all lie within expansions class 1 ($\pm 0.05 \cdot 10^{-6} \text{ K}^{-1}$)

Total CTE homogeneity of mirror segments for the HET, KECK and GRANTECAN projects

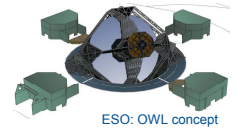
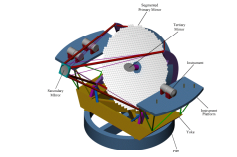


All CTE homogeneity values lie fairly within $0.02 \cdot 10^{-6} \text{ K}^{-1}$

At present the available production capacity at SCHOTT would be sufficient for 200 – 400 ELT mirror blanks per year if not used for other purposes.

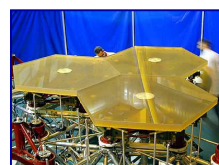


50% Lightweighting can be achieved in an efficient cost-saving way



Highly repeatable quality is crucial for optimizing large series polishing processes

SCHOTT mirror blanks in series:	
Keck I and II	85 1986 - 1993
HET	96 1994 - 1995
GRANTECAN	42 2000 - 2002
LAMOST	40 2001 - 2003



- ZERODUR is proven to be an excellent mirror blank material for segmented large telescopes
- ELT blank production can use established technology to achieve the sizes and quality required - no further process developments are needed
- Investments to achieve large quantities are already made Further expansion can be done in comparatively short time.

SCHOTT is experienced and economically stable enough to provide mirror blanks with highly repeatable quality for the time periods needed of about 6 – 7 years

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Workshop on Instrumentation for Extremely Large Telescopes, Ringberg Castle 25.-29. July 2005

SCHOTT
glass made of ideas