Gooch & Housego

SURREY SATELLITE TECHNOLOGY LTD

Lightweight Optics -

Bonded Mirror Structures

Peter MacKay

Innovations in Remote Sensing

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Centre for eo Instrumentation

CATAPULT Satellite Applications

Lightweight Optics

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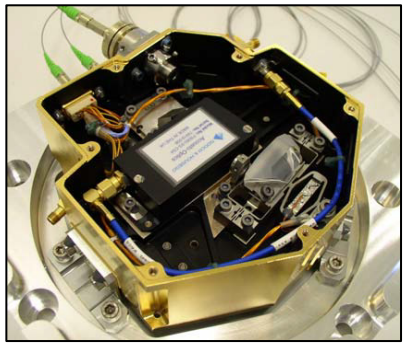
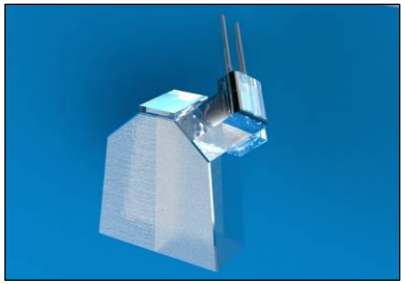
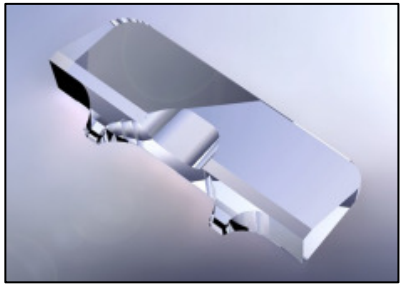
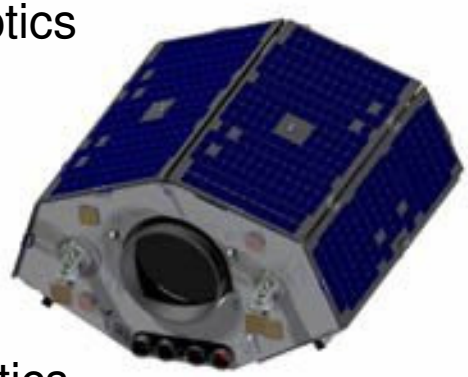
Lightweight optics

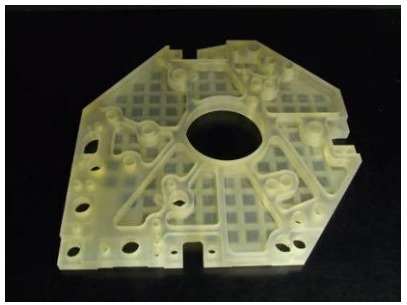
Company background











G&H

- Multinational and serve many markets
  - Industrial, aerospace and defence, biomedical and research
- Some space heritage
  - Acousto-optics and Fibre optics
- Precision polishing of prisms
- Crystal optics
- Coating and polishing precision optics
- Machining of zerodur
- Bonding using optical contacting
- Bonding using epoxies

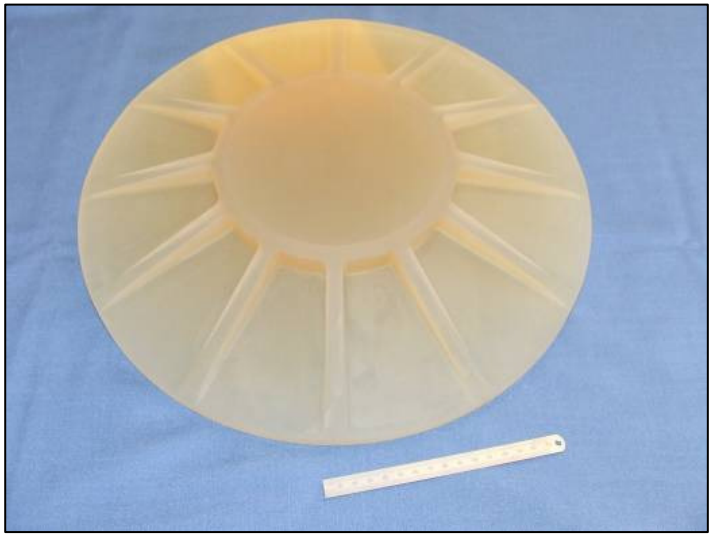
SSTL

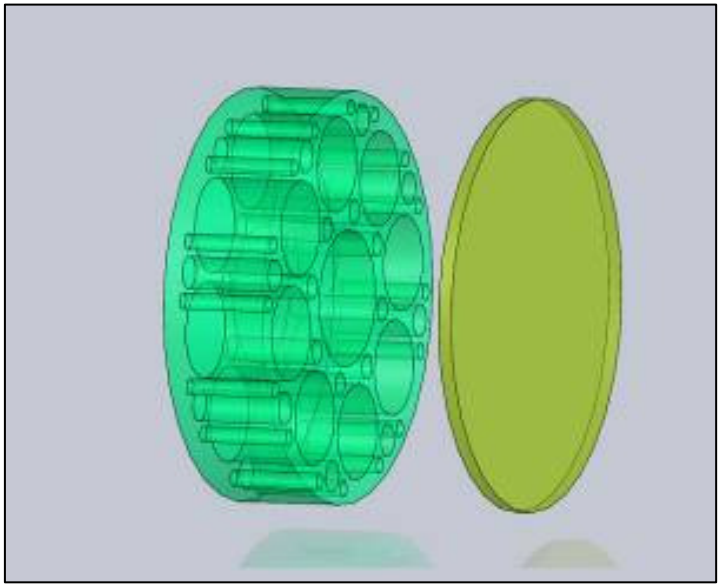
- Experienced designer of space optics
- Have ongoing requirements for lighter and stable optics.

Lightweight optics

Project background

- Mirrors for space applications
  - Light
  - Stable
  - Robust
- Current production methods
  - Risky
  - Slow
  - expensive monolithic structures
- Proposed production method
  - Lower risk
  - Quicker
  - Lighter for same performance

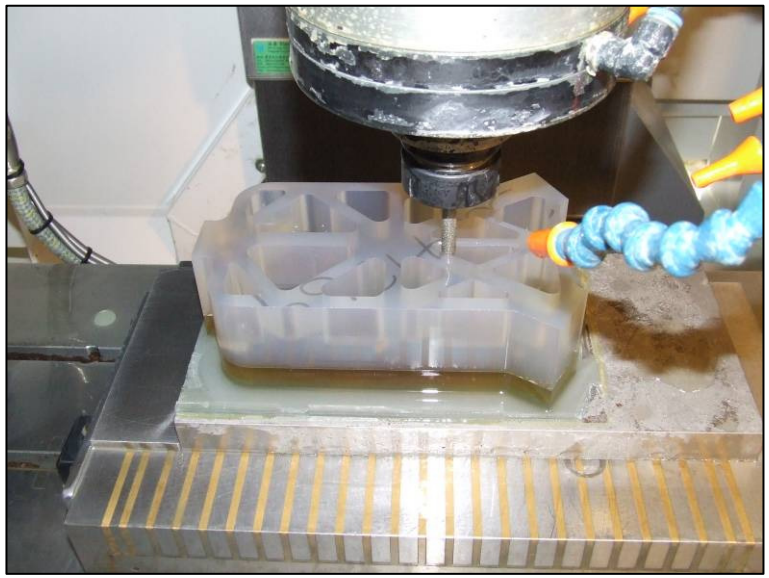




Lightweight optics

Current production method

- Start with large block
- Machine away unwanted material
- Limitations:
  - Large amounts of grinding waste
  - Limited design options
  - Part at most fragile at the end of machining process



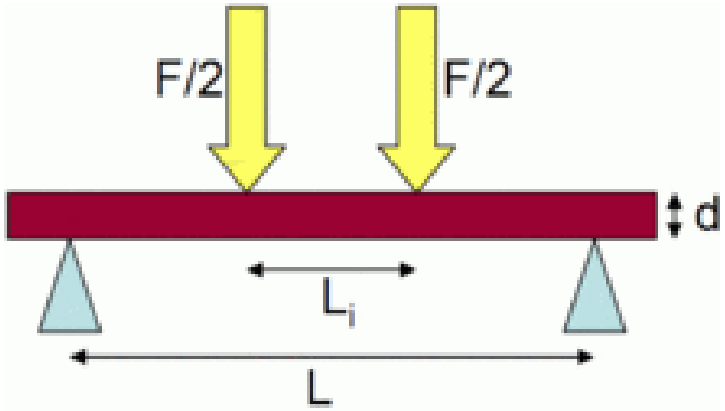
WP1 – Select bonding method

Zerodur and ULE substrates:

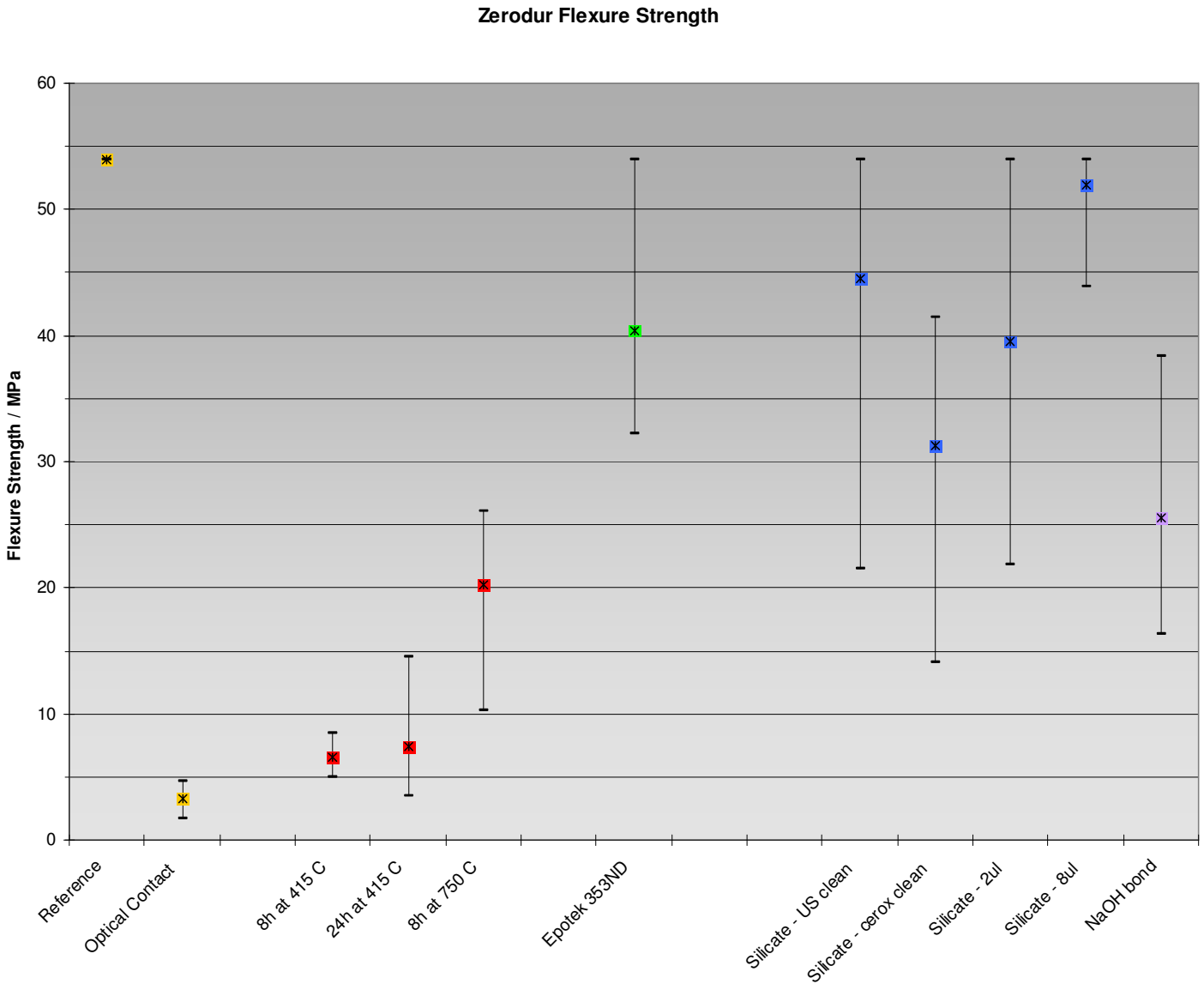
- Epoxy free (CTE and outgassing benefits)
- Diffusion Bonding (600°C)
- Adhesive Free Bonding (<100°C)

Use test pieces and 4 point bend test rig.

- Adhesive free bonding selected.
- (52MPa vs 40MPa (epoxy))



WP1 – Strength Tests

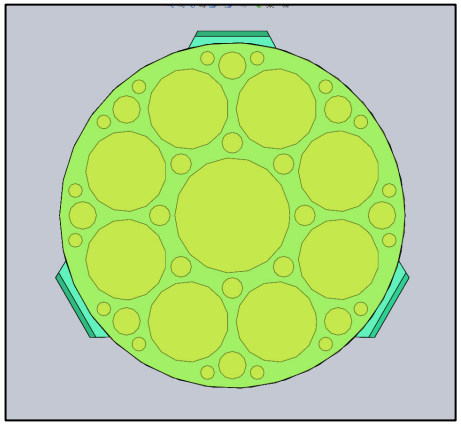


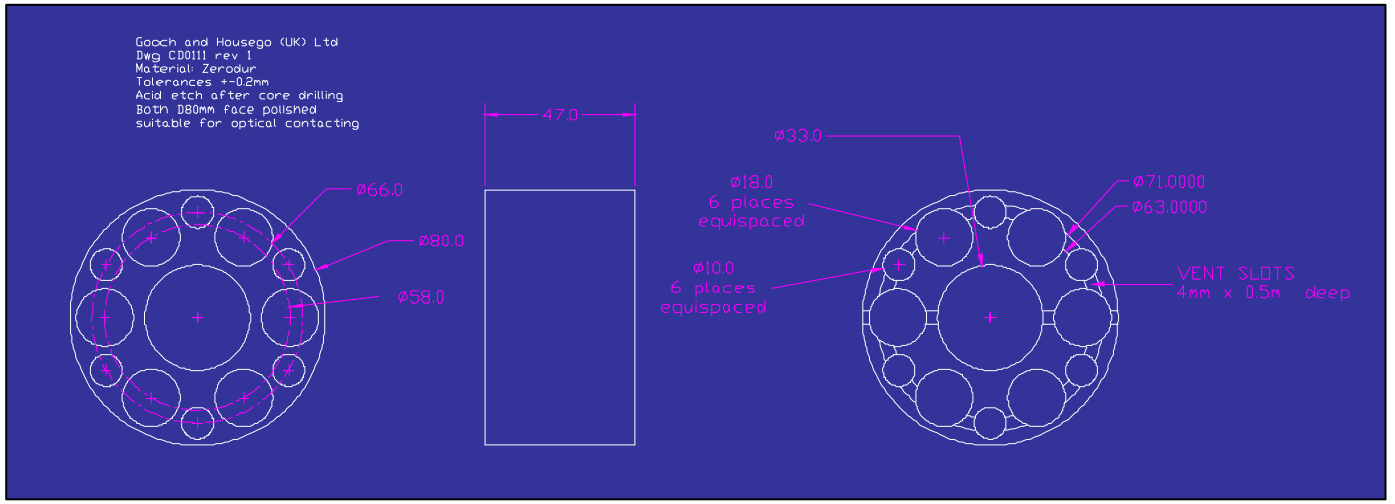
Lightweight optics

WP2 and WP3 Bonded Mirror substrates

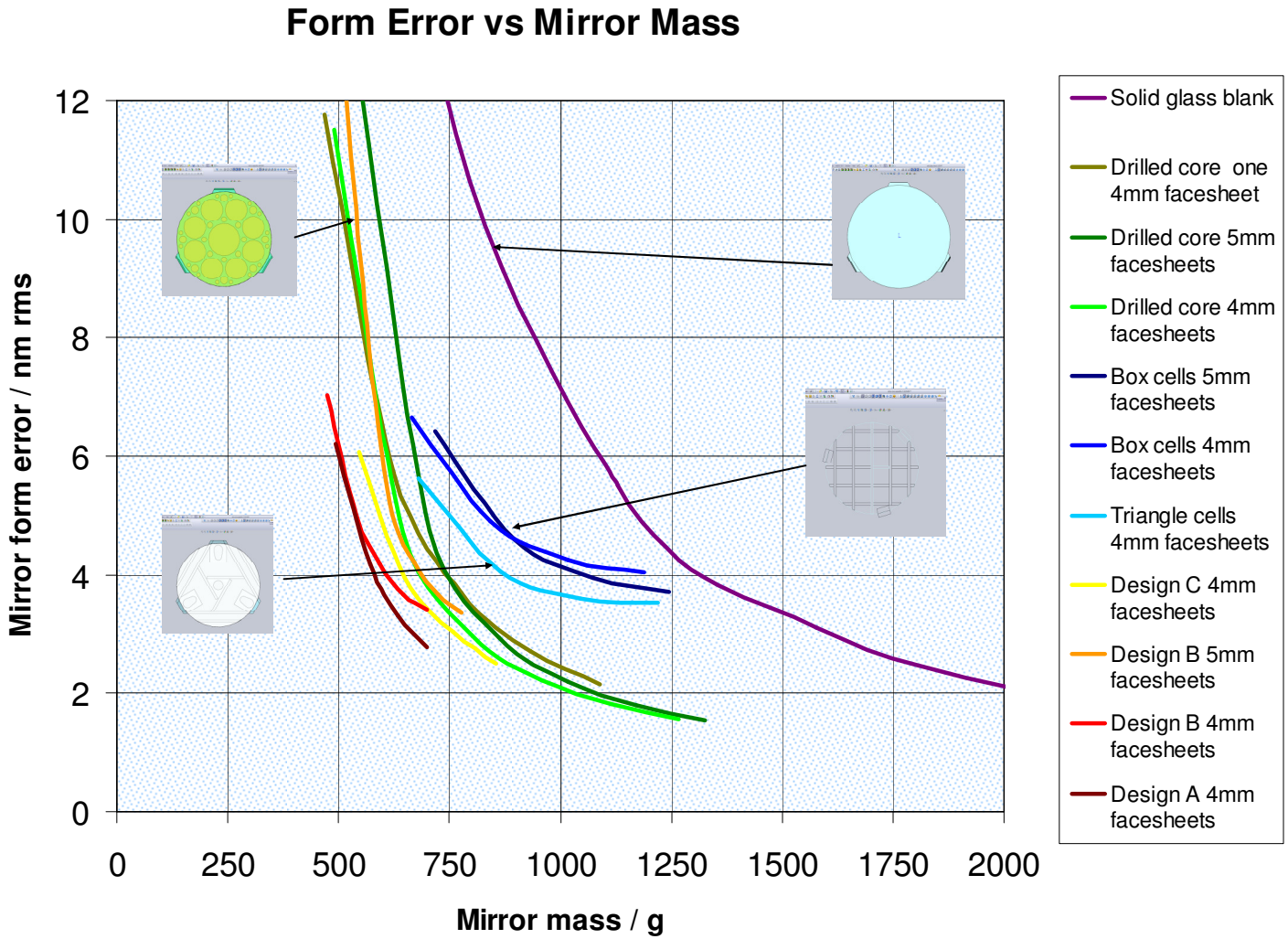
Analysed design options

Selected best designs for fabrication





Lightweight optics



Lightweight optics

Technology Exploitation Opportunities

- High stability designs
- Low outgassing requirements
  - UV optics and UHV optics
- Higher laser fluences
  - More robust than epoxy in the optical path
- Un-machineable monolithic designs
  - Undercuts and hollow chambers
  - Complicated prisms
- Other substrate materials
  - Fused silica, glass, quartz
- Permanent optical breadboards
  - Robust permanent alignment of glass components on a low CTE baseboard
- Coated surfaces can be bonded
  - Beamsplitters

Lightweight optics

Project Team

Peter MacKay
Gooch and Housego (UK) Ltd, Somerset
pmackay@goochandhousego.com
Tel: 01460 256440

Trevor Wood
Surrey Satellite Technology Ltd, Guildford
t.wood@sstl.co.uk
Tel: 01483 803803