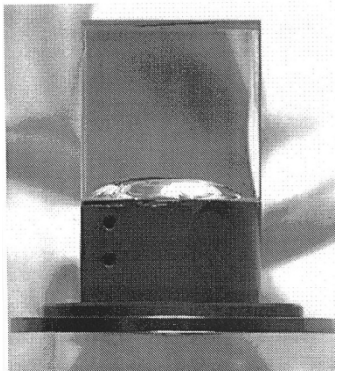
OPTI 523 Project Requirement

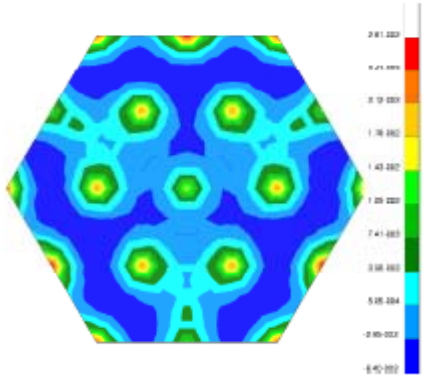
Tianquan Su

Local stress analysis at the bond area

Problem

- **Difference-CTE-caused stress often impairs the performance. (especially under low temperature)**
  - Crack the glass
  - Deform the mirror





- So it's necessary to study how the stress develops.
- (No general study yet)

Problem

- CTE (ppm/K)
- Aluminum – 23; Optical Glasses 3 – 10;

- Epoxy 2216 81 – 207;
- RTV 270;
- Cyanoacrylates 80;
- Acrylic 75.

Problem

- Usually ignore the adhesive expansion during analysis nowadays

$$\tau_{\max} = \frac{(\alpha_1 - \alpha_2) \quad \Delta T \; G \tanh(\beta L)}{\beta \; h_r}$$

$$\beta = \left[\frac{G}{h_r} \left(\frac{1}{E_1 h_1} + \frac{1}{E_2 h_2} \right) \right]^{\frac{1}{2}}$$

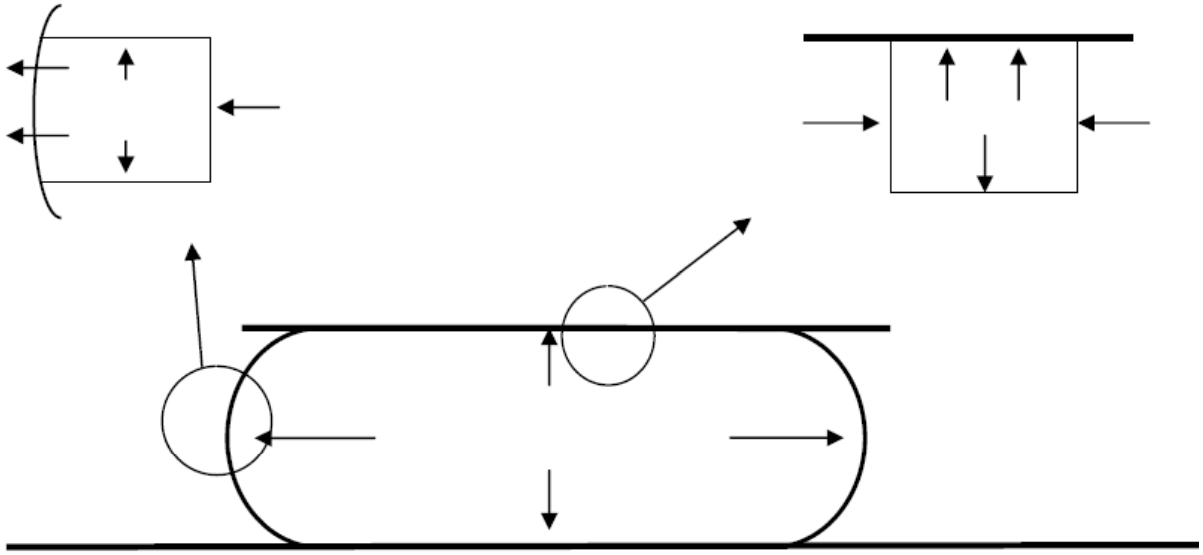
- 1-D, linear, excluded adhesive expansion

What to do

- **Analyze the local stress considering adhesive expansion**
- Glass-aluminum bound
- Adhesive: Epoxy, RTV, Acrylic
- Single bound: thickness, bond area
- Temperature: heat up (no thermal gradience)

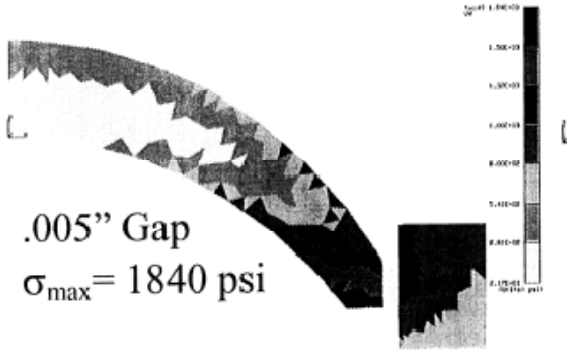
Finite Element Analysis

- Use programs (Cosmos or other), 3D, non-linear
- More detail on the edges, boundary conditions
- Interferometer test – Check



Goal

- Curves with different axis: stress-thickness, stress- area, stress- temp, temp-deformation …
- Stress distribution



- Useful datum for mirror mounting design