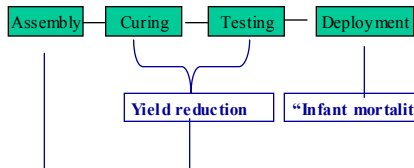


# Dimensional Stability of Optoelectronic Adhesives

Ray Pearson, Guy Connelly, Tom Green,  
Jeff Shakespeare, Vikas Gupta, Joachim Grenestedt, and Herman Nied

COT Partner - High Density Packaging Users Group: Bob Sullivan

## Motivation



Adhesives are the main factor to optoelectronic module instability and misalignment loss.

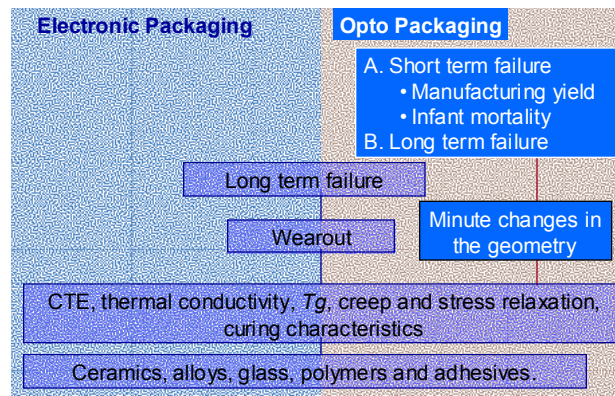
## Objectives

- The project is designed to be pre-competitive
- The major goal is to develop a knowledge and database system enabling materials selection for assembly of dimensionally stable optical and optoelectronic modules.
- Develop longer range strategy for optoelectronic packaging

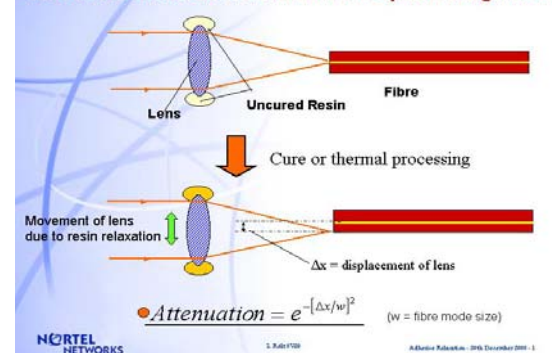
## Approach

- Select appropriate adhesives (3 chosen)
- Characterize viscoelastic properties of adhesives.
- Assemble test vehicles.
- Model behavior of test vehicles.
- Verify model(s) by measuring the performance of test vehicles.

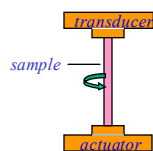
## Background



### Effect of Adhesive Relaxation on Optical Alignment



## Adhesive Characterization

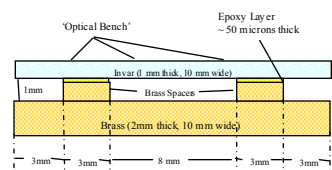


At 0 °C the mechanical behavior is nearly elastic

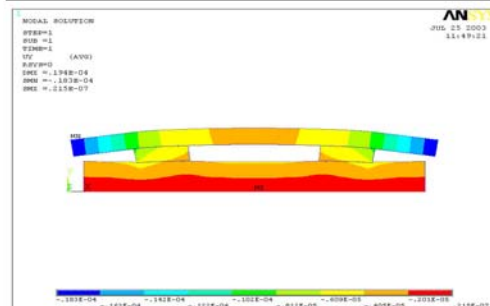
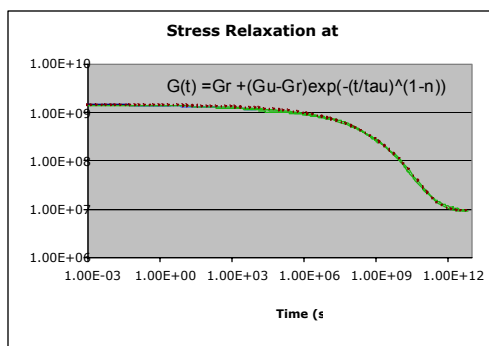
At 60 °C the mechanical behavior is viscoelastic.

At 100 °C there is some evidence of plasticity.

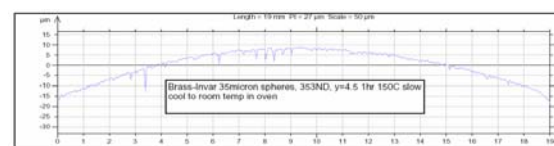
## Test Vehicle Modeling and Verification



- Several Brass/Invar test vehicles were made.
- Adhesive was modeled as a stretched exponential
- FEM model used a Prony Series for the adhesive
- TVs were thermally cycled 10 times from 0 to 100 °C
- An Optical Profilometer was used to measure warpage



Sample #	Warpage Before (µm)	Temp Cycle Type	Warpage After (µm)
BI-5	25.3 ± 2.3	10 cyc 25-0	22.8 ± 5.7
BI-6	26.4 ± 1.4	10 cyc 25-0	28.9 ± 1.0
BI-7	21.7 ± 1.0	10 cyc 25-100	20.0 ± 2.6
BI-8	33.2 ± 0.2	10 cyc 25-100	29.5 ± 2.1
BI-9	23.8 ± 1.2	10 cyc 0-100	27.9 ± 2.7
BI-10	31.7 ± 0.7	10 cyc 0-100	30.7 ± 0.5



FE Modeling and Optical Profilometry are in good agreement.

Differences in measured warpage has been attributed to bond line thickness control and adhesion.

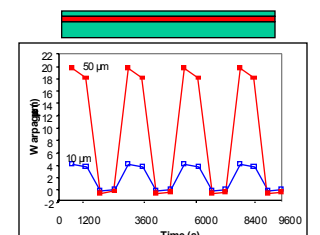
Additional FE studies (not shown) have revealed that this test vehicle is not suited for evaluating adhesives.

## Conclusions

- A methodology for characterizing the dimensional stability of optoelectronics adhesives has been established.
- A database is being assembled.
- A knowledge base that uses FE modeling has also taken form.
- Verification of this approach needs a new test vehicle

## Future Work

New Test Vehicle are more sensitive!



## Acknowledgements

Supported by PA and HDPUG. HDPUG participants include Nortel Networks, Agilent, National Semiconductor, Loctite, Cookson, and Celestica