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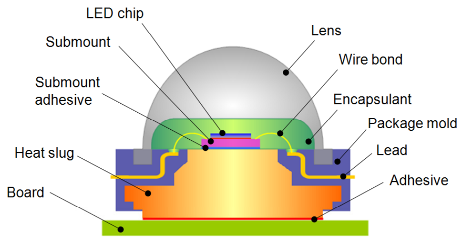
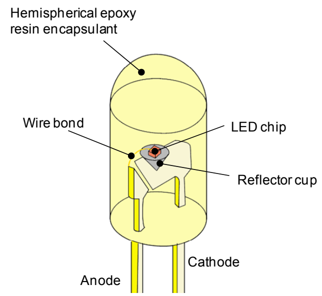
Analysis of High Power LED



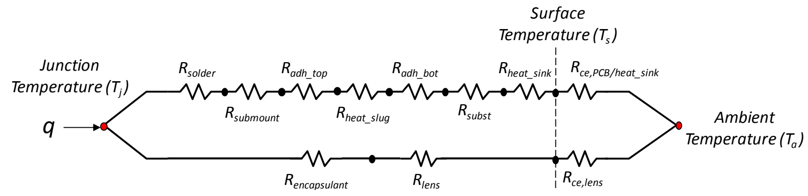
HP LED

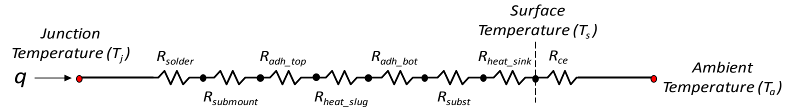


Indicator LED

- High junction temperature
- Heat sink slug with low thermal resistivity
- Silicone-based encapsulant which prevents yellowing effect

Reduced resistance network model of an LED package





$$q = \frac{T_s - T_a}{R_{cr}} = \frac{T_j - T_s}{R_{cd}} \Leftrightarrow T_j = \left(R_{cd} + R_{cr}\right) q + T_a$$

- Junction temperature can be obtained by using thermal resistance network.

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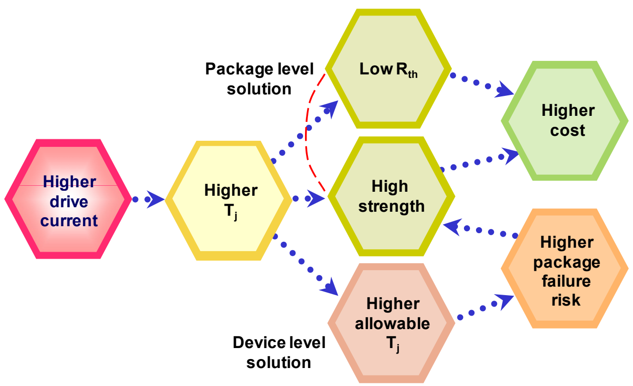
Design trade-off HP LEDs



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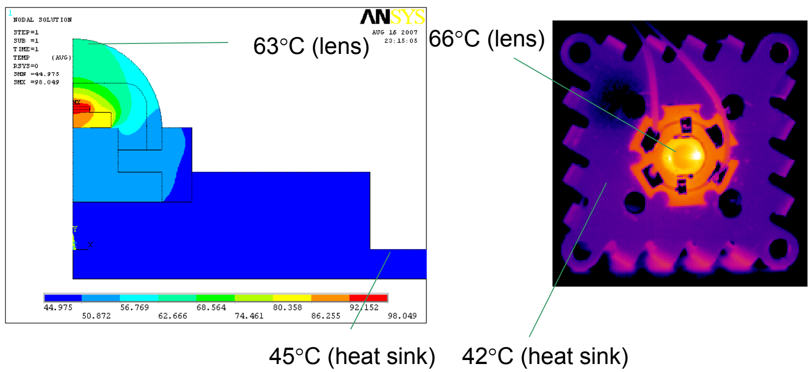
Validation of thermal conduction model

- The result from the FE analysis agrees reasonably well with the measurement data considering uncertainties associated with material properties and contact resistance as well as leads that are not included in the model.



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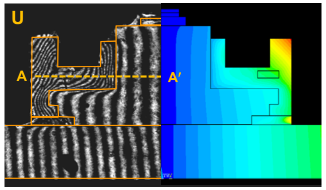
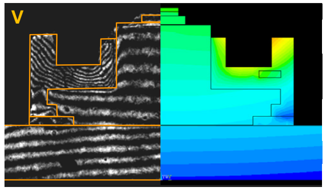
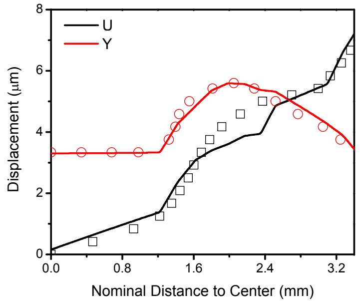
Validation of thermo-mechanical model



U field strain

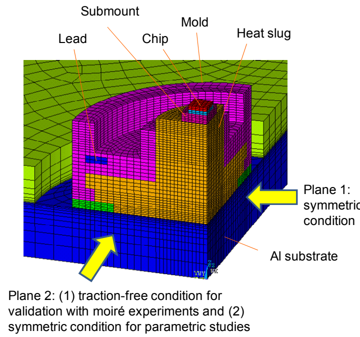


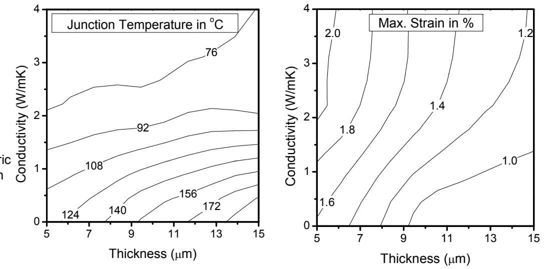
V field strain



- Moiré interferometry is utilized to validate the in-plain displacement of the LED package

Parametric study using FEM





The 3-D model is used to investigate the effect of the thickness and thermal conductivity of the top adhesive layer on the junction temperature and the maximum effective strain.

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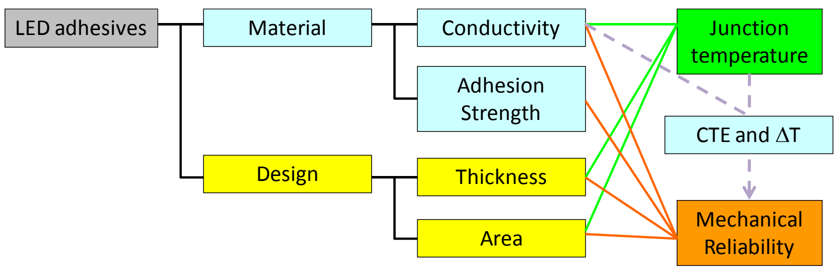
Adhesive parameters affecting the junction temperature and stresses of high power LEDs

$R_{adh} = t / kA$ $\gamma = f(\Delta\alpha, \Delta T, DNP, t, constraint)$



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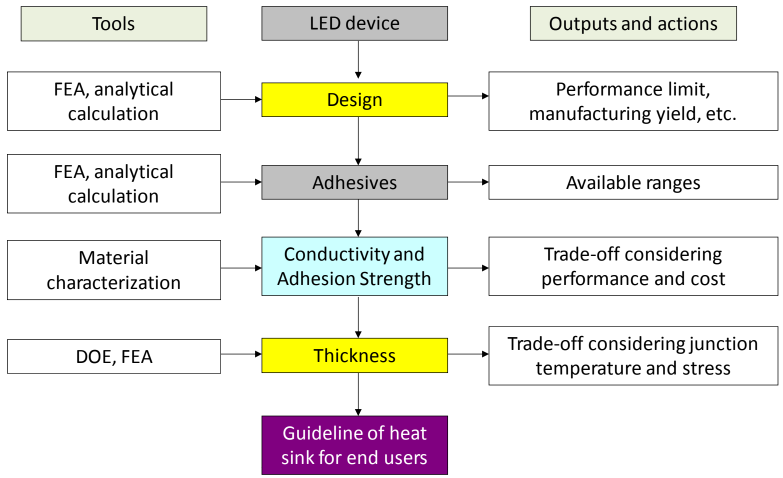
Design guidelines of HP LED



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