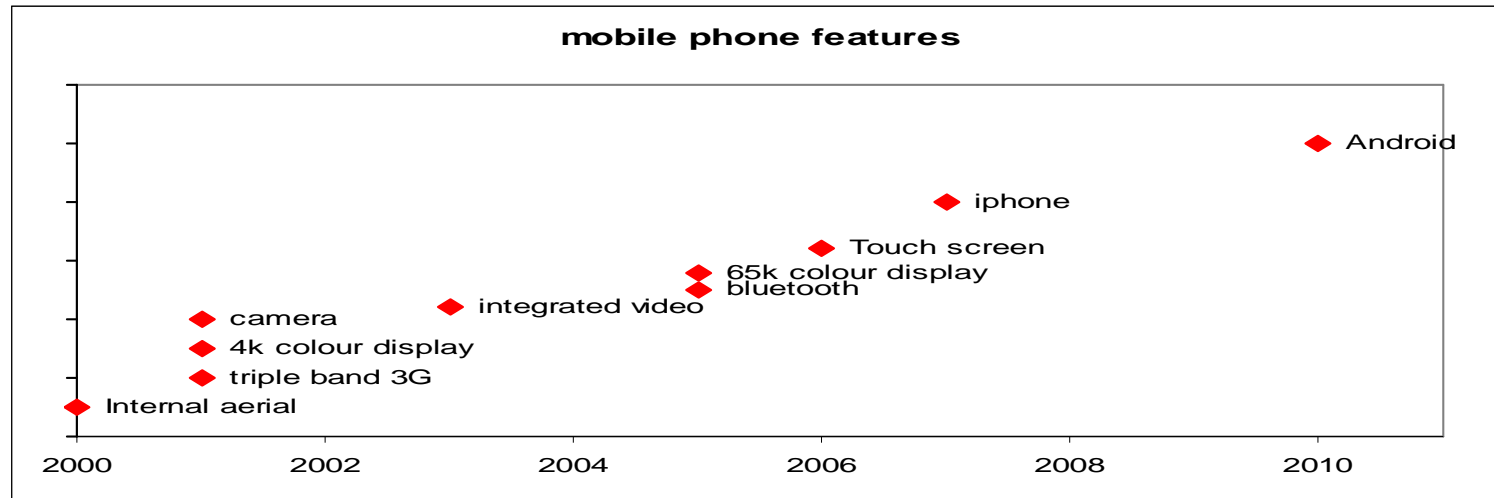


FR4ever?

Holdings Technology

Arundel - March 2011

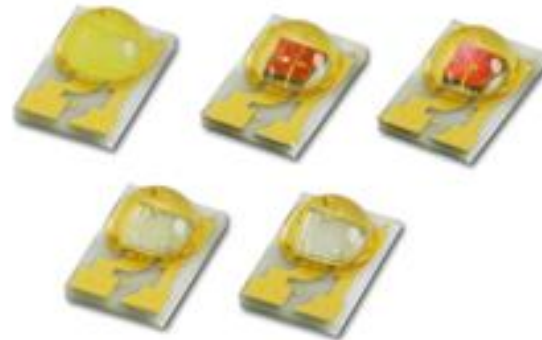
market forces at work - mobile phone



Courtesy of Nokia, Apple, HTC

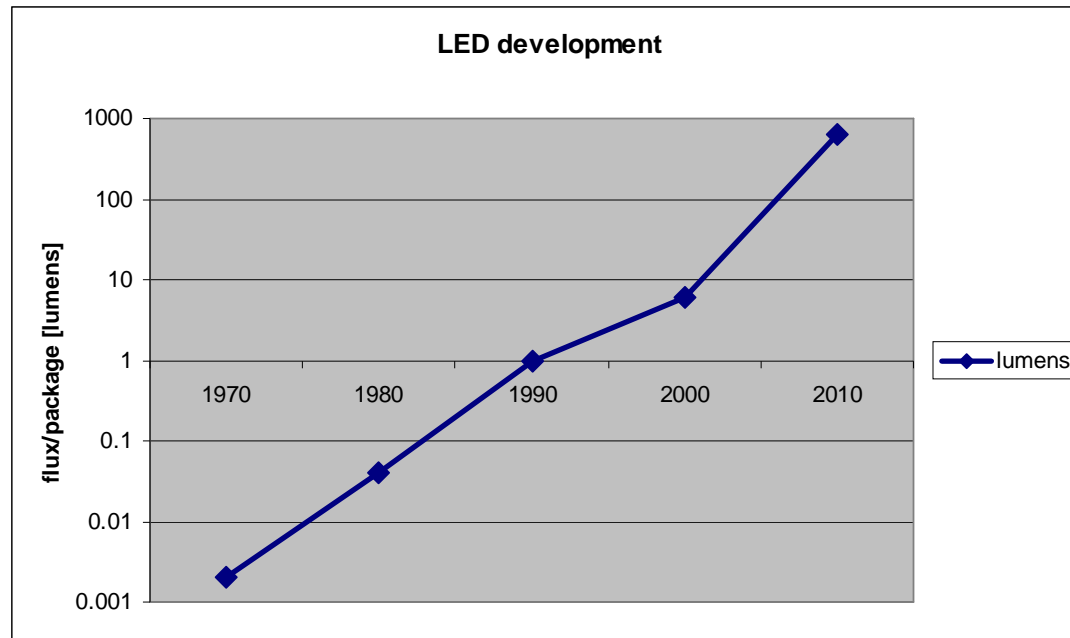
growing market for high brightness LEDs

- solid state lighting uses
- high brightness LEDs (power semiconductors)
- high power density (1, 3, 5W per device)
- array formats



Courtesy of Edison Opto

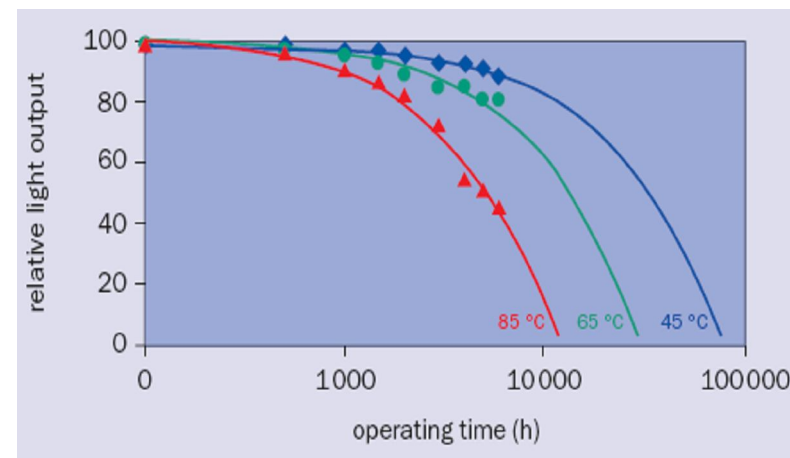
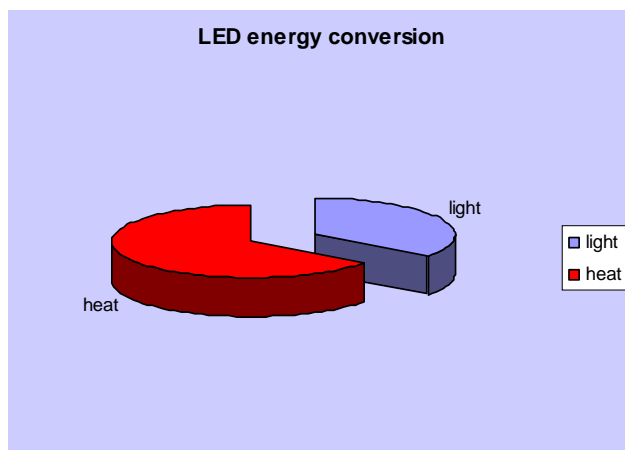
LED development



- Acknowledgement to HAITZ for data 1970-2000
- updated from commercial sources to current date

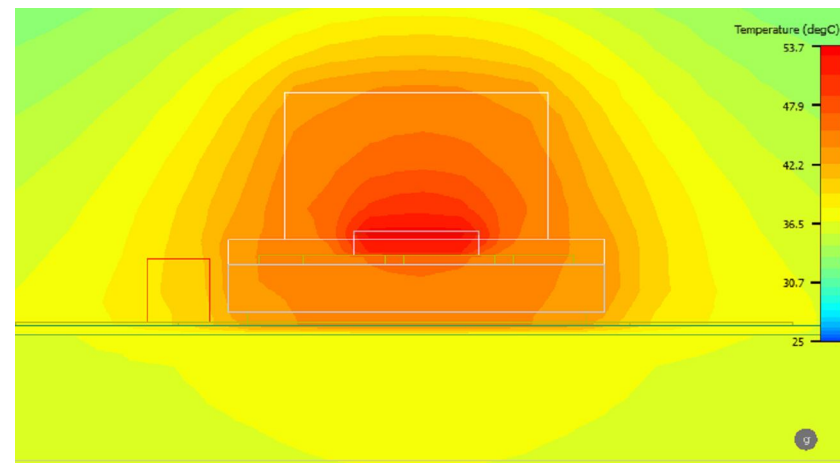
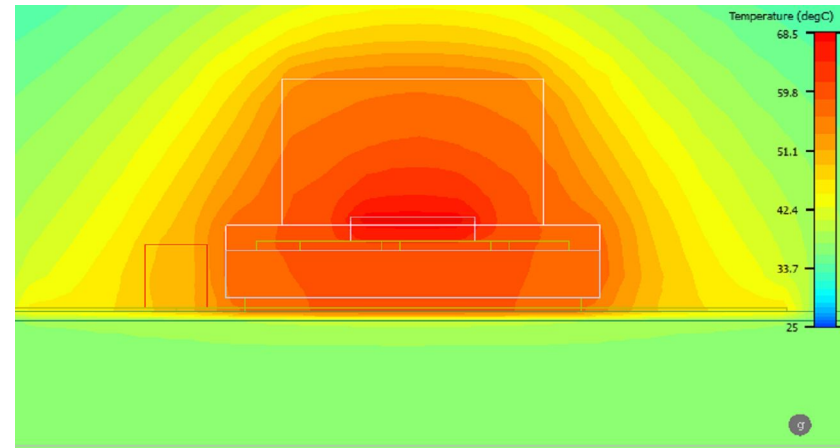
special needs of LEDs

- power semiconductors generate significant heat
- unless this heat is removed the junction temperature will become excessive – temperature overstress
- increased temperature
 - reduces device lifetime
 - deteriorates device performance



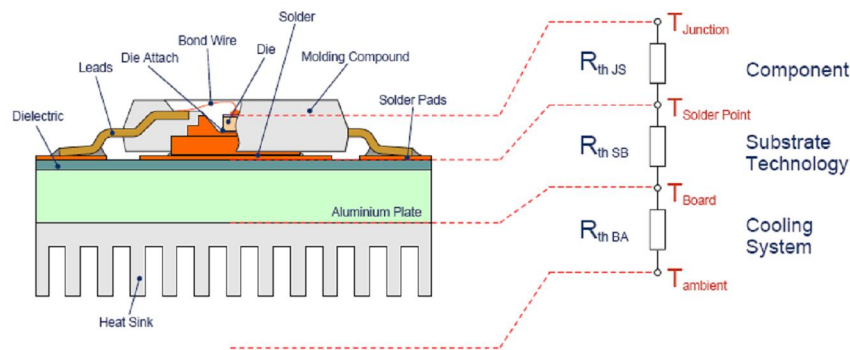
the substrate in thermal management

- the substrate has an essential role in the removal and dissipation of heat from the device
- limited by its thermal resistance the dielectric layer will conduct heat from the surface copper through the bulk of the dielectric
- base layer is key to dissipating heat to attached hardware/heatsink and to the dissipation of heat by convection to air



avoiding thermal overstress

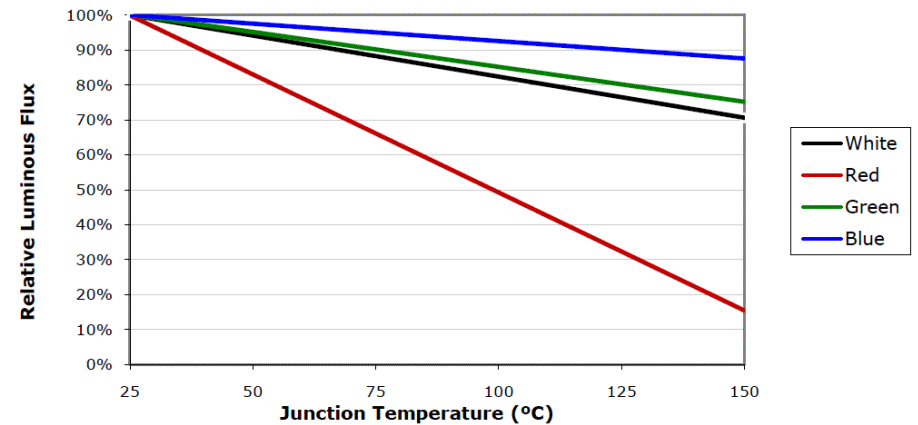
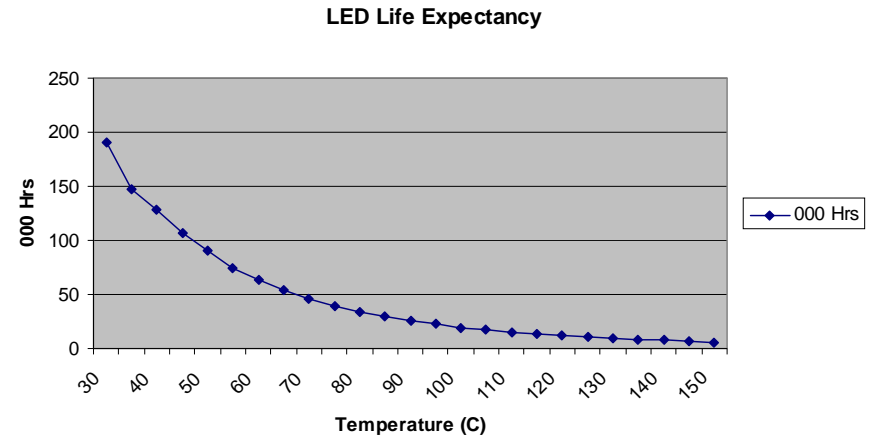
- Substrates with enhanced thermal conductivity reduce thermal stress



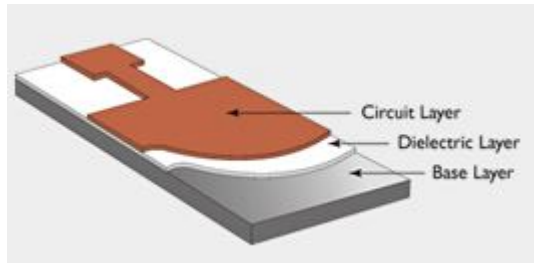
Substrate type	Thermal resistance
PCB with enhanced dielectric and aluminium base layer	3.4
PCB with FR4 dielectric and aluminium base layer	7.3
Flex PCB on aluminium with standard PSA	9.5
Flex PCB on aluminium with thermally enhanced PSA	7.6
FR4 PCB glued on aluminium with thermal vias	9.7

benefits of reducing junction temperature

- lower temp means longer life (Arrhenius law)
- Lower temperature means higher output
- Lower temperature means reduced colour shift

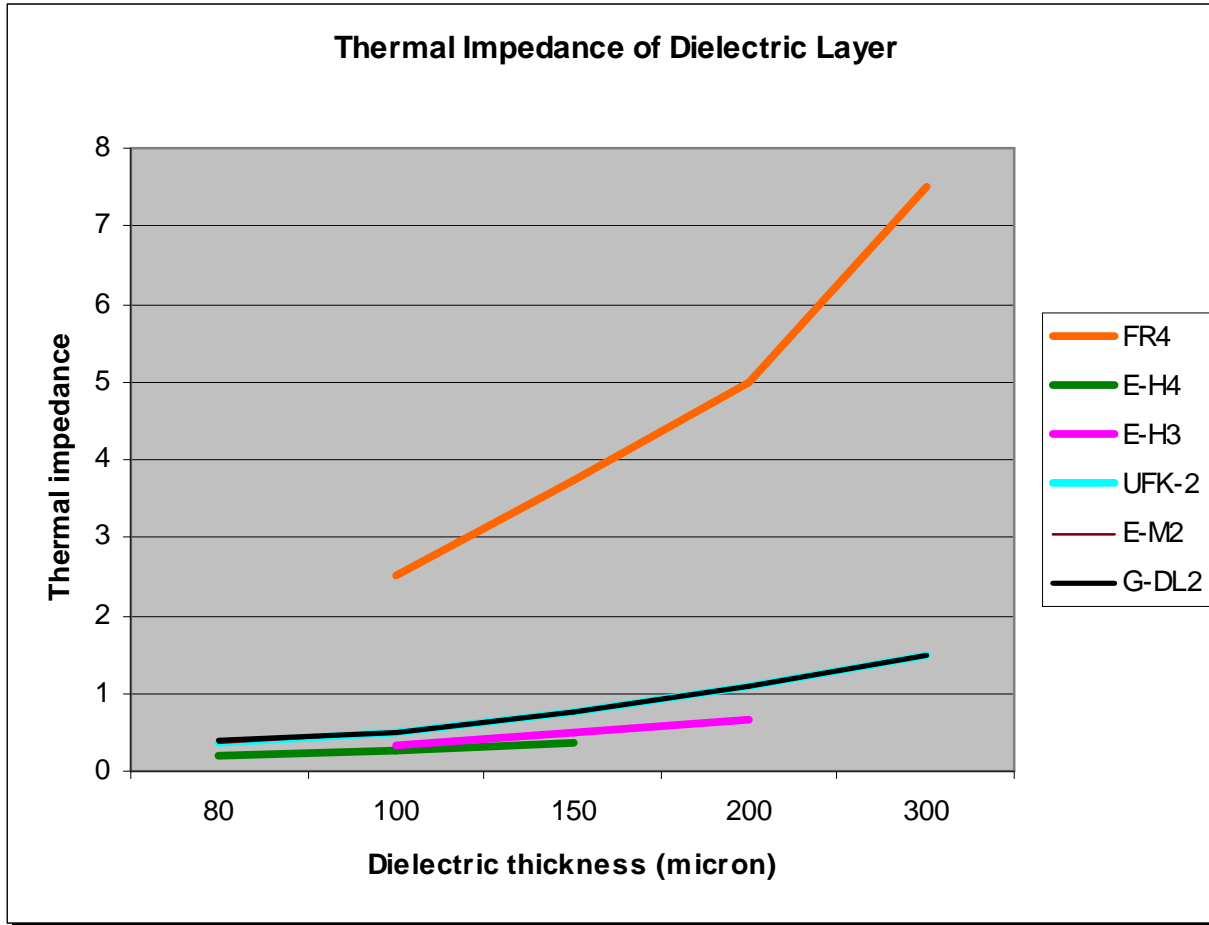


Structure of Al clad thermally conductive laminates



- Copper circuit layer
- Thermally conductive Dielectric
 - offers electrical isolation with minimum thermal resistance
 - Two types available (film type or glass fabric reinforced) (Glass carriers degrade thermal performance but can benefit isolation and strength at temperature)
 - Thickness affects isolation property
- Metal layer (base layer)
 - normally aluminium

the challenge to FR4



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- Definitely not FR4everything

thank you