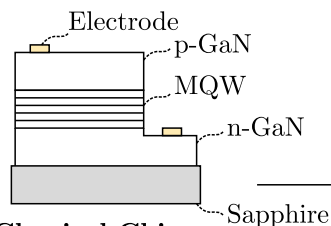
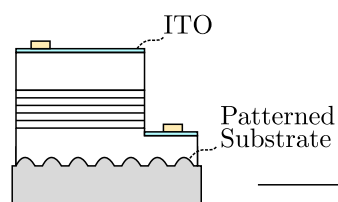


Panel A



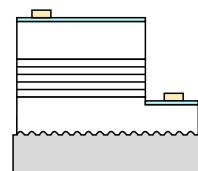
### Classical Chip

Lateral Current Spreading  
No Substrate Manipulation  
No Surface Manipulation  
*Shown: Nichia, 1997*



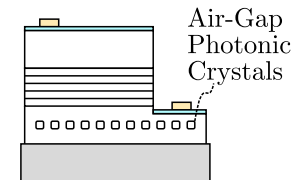
### Classical Chip

Lateral Current Spreading  
Patterned Sapphire Substrate  
No Surface Manipulation  
*Shown: Nichia, 2012*



### Classical Chip

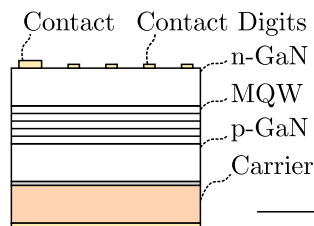
Lateral Current Spreading  
Patterned Sapphire Substrate  
No Surface Manipulation  
*Shown: Generic, 2015*



### Classical Chip

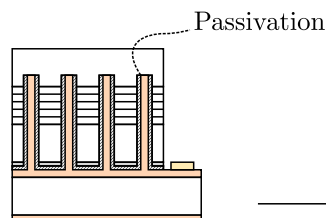
Lateral Current Spreading  
No Substrate Manipulation  
No Surface Manipulation  
*Shown: Lumileds Lab, 2002*

Panel B



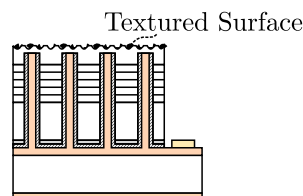
### Vertical Chip

Osram Pre-UX:3 Technology  
No Substrate Manipulation  
No Surface Manipulation  
*Shown: Osram, 2000*



### Vertical Chip

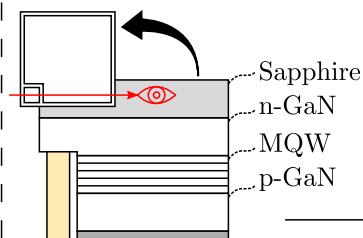
Osram UX:3 Technology  
No Substrate Manipulation  
(Likely) Textured Surface  
*Shown: Osram, 2007*



### Vertical Chip

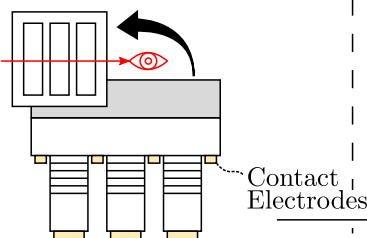
Osram UX:3 Technology  
Patterned Substrate  
Textured Surface  
*Shown: Osram, 2014*

Panel C



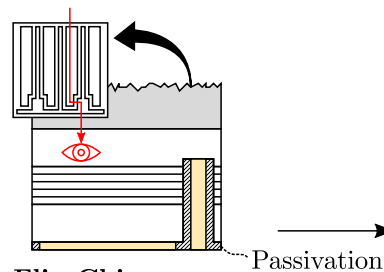
### Flip-Chip

Early Technology  
No Substrate Manipulation  
No Surface Manipulation  
*Shown: Lumileds, 1997*



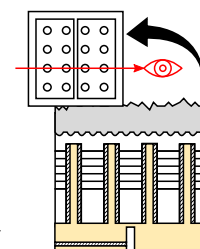
### Flip-Chip

Current-Spreading Areas  
No Substrate Manipulation  
No Surface Manipulation  
*Shown: Lumileds, 1997*



### Flip-Chip

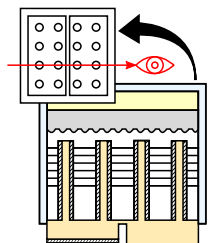
Current-Spreading Fingers  
No Substrate Manipulation  
Surface Texture  
*Shown: Lumileds, 1997*



### Flip-Chip

Current-Spreading Vias  
Patterned Substrate  
Surface Texture  
*Shown: Lumileds, 2014*

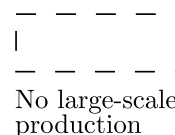
Panel D



### Chip-Scale Flip-Chip

Current-Spreading Vias  
Patterned Substrate  
(Sometimes) Surface Texture  
*Shown: Osram, 2014*

### Legend (Other):



No large-scale production

### Legend (Materials):



Sapphire



Phosphor



Gold



Conductive Material



n/p-GaN



Epoxy



Silver



ITO



Passivation