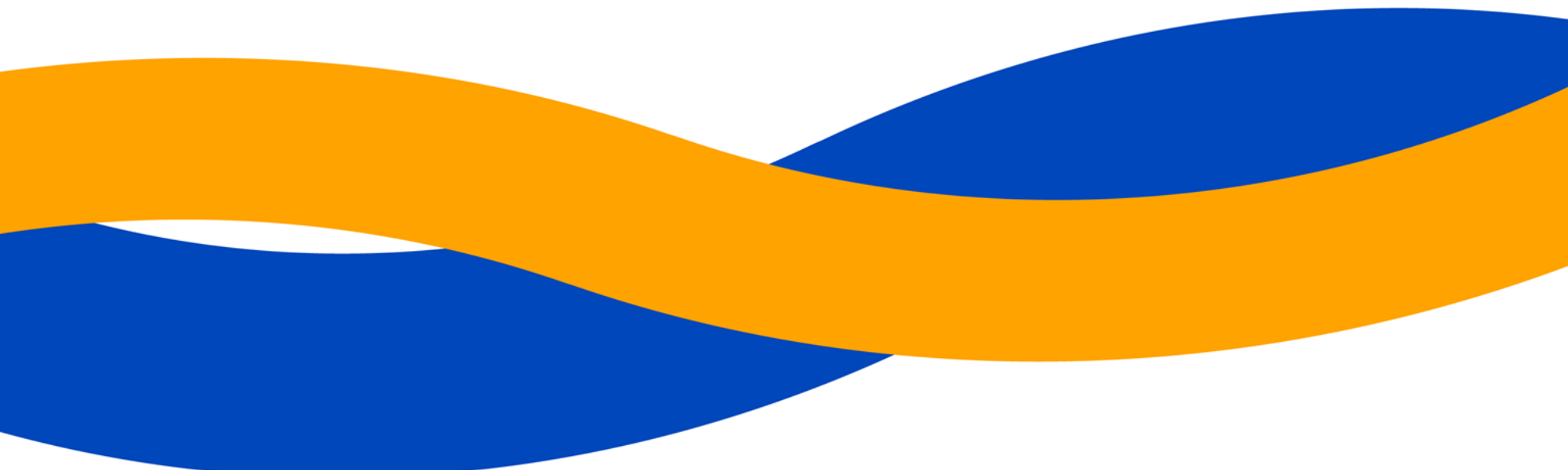




Products For LED Lighting Cover



CHEMISTRY THAT MATTERS™

Thin Gauge Sheet for LED Lighting Covers

Application: LED Lighting Covers

Program Description: Thin diffusion sheet for LED lighting covers through leveraging the synergy btw lens-texture and diffuser particles to achieve the best-in-class light output/hiding power balance.

Validation Customers: Philips, Osram

Competitive Product:

Traditional diffusion sheets with diffuser and/or random surface textures.

CTQ's:

- Thickness $\geq 0.8\text{mm}$, $< 2\text{mm}$
- High %LT for light cover
- Various hiding power, depending on application
- Uniform Light distribution
- Fast response & short lead time (tight timeline for Lighting industry)
- (Optional) FR performance, V0 or V2 depends on OEM

Value Proposition:

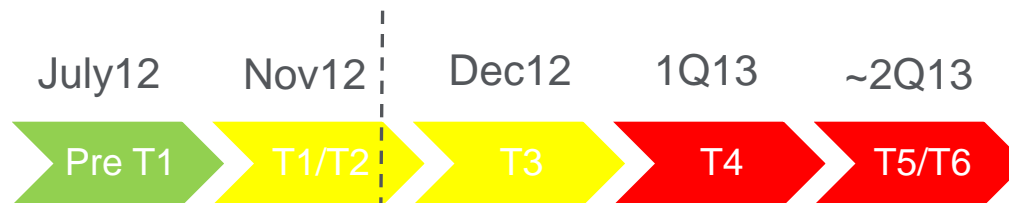
- Unique product with synergy btw Lens-texture and Diffuser particles
- Best hiding power with high light output in thin gauge sheet
- V2 pass, 0.8~1.2mm range
- Local supply

Key Actions/Next Steps:

- Investigate the synergic effects btw lens texture and diffuser loading
- Lab run in CTC to scope the lens texture and diffuse type/loading
- 7 preliminary grades produced for customer validation
- FTP Check, Patent draft submitted
- Positive feedback from Philips/Osram, potential commercial order from Osram
- steel roll got re-graved with selected texture
- Raws ready for scale-up trial in Dec, also to prepare sample for final testing in Osram

Team Members & Project Timeline

Team Members	
Product Manager	Chunmin Wang
Technology Manager	Zhe Chen
Commercial Owner	Jessie Zhang, Gordon Chao
Marketing Manager	Chunmin Wang
Product Developer	Yafeng Sun
Manufacturing Owner	Hiker Zhou/Baker Cai
Color Tech Owner	Jos Dekkers
Additional Reviewer	Tjahjadi, Mahari
Additional Reviewer	Polo Lu
Additional Reviewer	Lennard Markestein



Market:

- Lighting market **highly fragmented**
- Incandescent, replacement market shrinks (higher lifetime)
- LED Lighting will dominate market in coming decade
- **Maintenance** is driver for commercial lighting

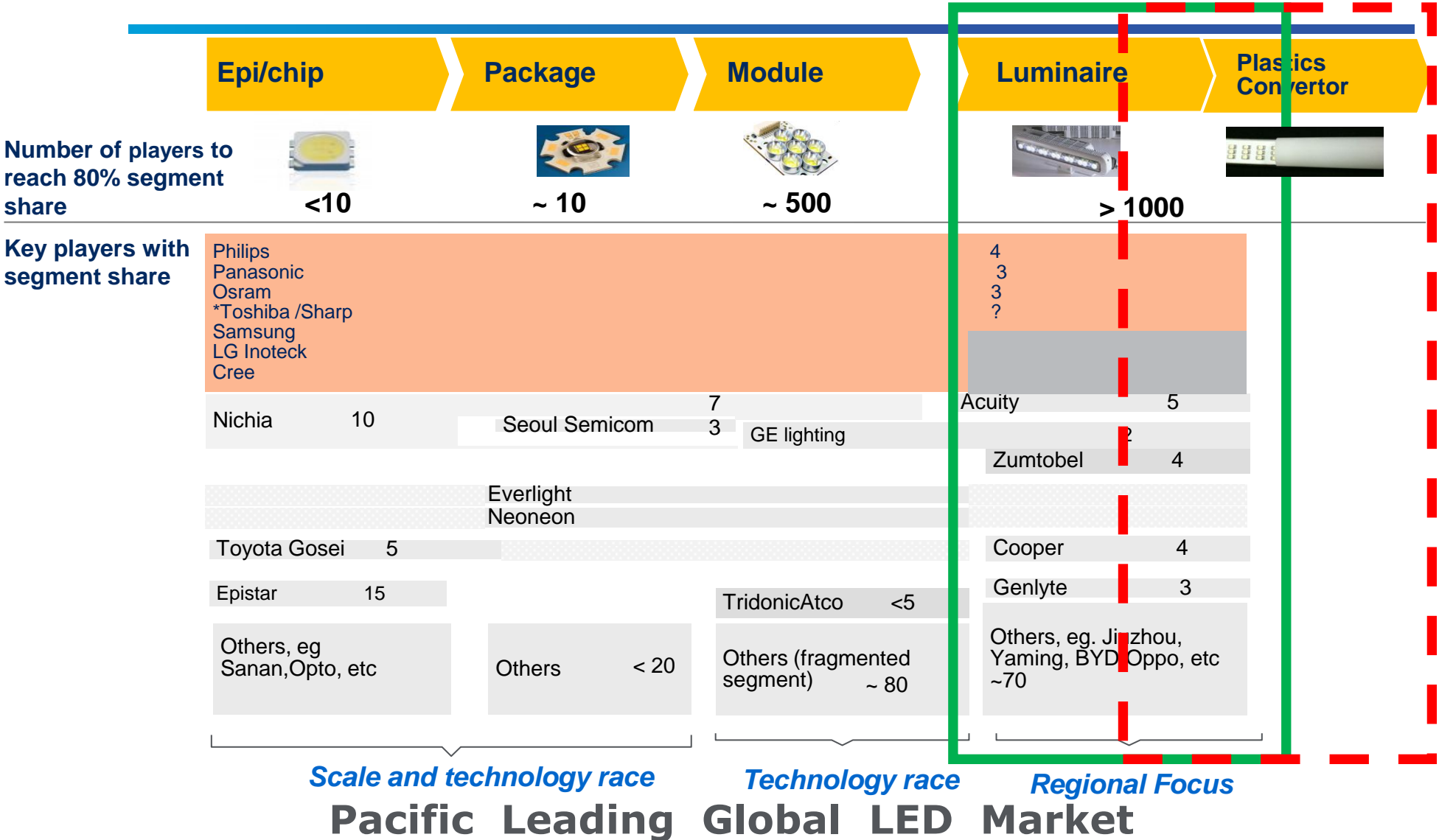
Legislation:

- WW different Legislations and NO final standards yet (Zhaga, UL, IEC, EN)

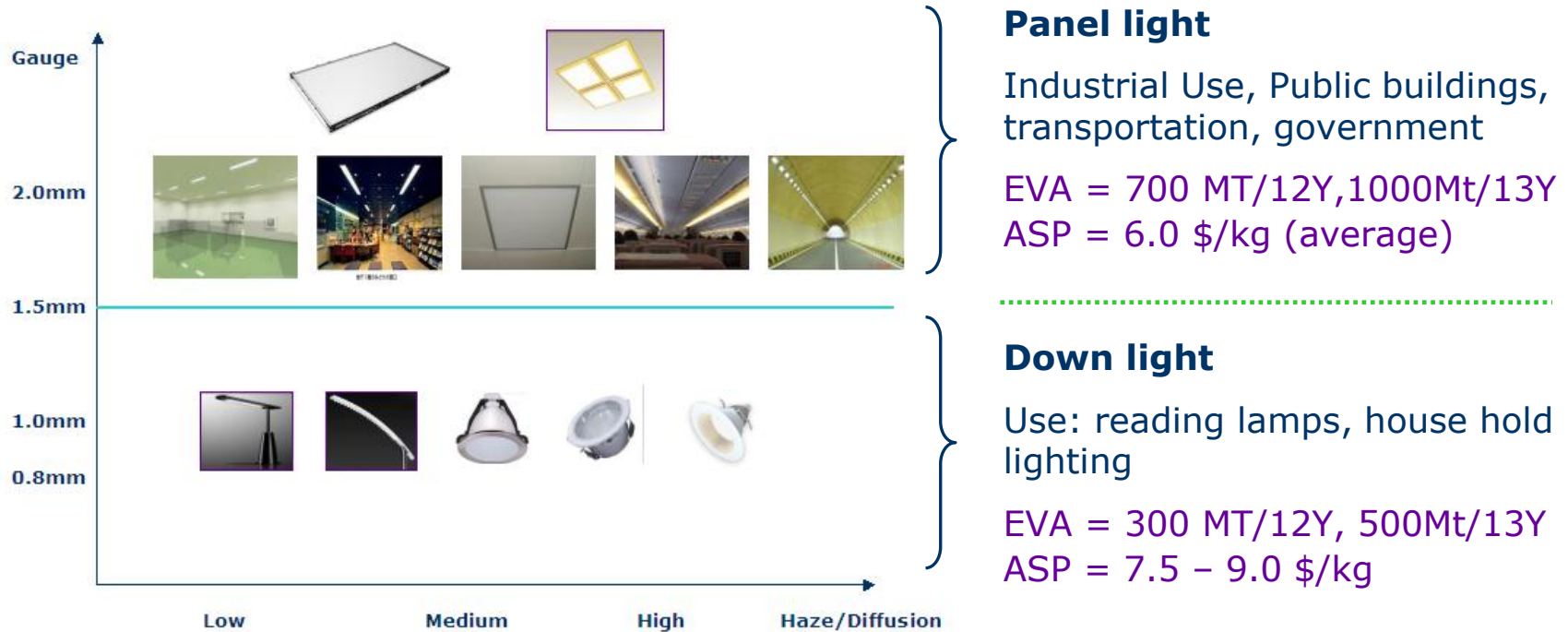
Trends:

- More lighting appl. will be replaced by LED solutions
- **Long life time** (up to 25y) **goal** → original equipment
- Continued LED chip cost reduction, luminance increase

Where Are Our Customers?



LED Panel light opportunities for SF&S



CTQs flow down

Y: Customer CTQs

Hiding
powder

Light
output

Light
distribution

y: Internal CTQs

Diffusivity
DLD
Haze
Visual quality in
lighting system

Total luminous flux
Light transmission

Reflector design
Lens-optics design
Light cover surface
texture design

x: Process variables

Diffuser properties
Diffuser loading
Surface texture design
Texture replication
Processing conditions
Luminaire design

Resin properties
Diffuser properties
Diffuser loading
Colorant/dye
Texture design

Light collimating
element geometry
Texture replication

CTQ discussion (Panel/down light)

CTQ	Summary
Light output	High luminous flux in lighting system and high %LT for light cover, %LT>80% for down light cover and %LT>60% for panel light cover.
Hiding Power	Need to have several grades (3 grades) with low/medium/high hiding power , depending on application/environment. No.1 CTQ for most indoor applications (panel light).
ECO	Non Halogen is the trend, especially for EU, Non-Eco is OK for most local customers now.
FR	Depends on the application. Public/ government use/ transportation sometime require V-0, especially for those exported to US/EU. V-2 is enough for most general applications.
UV Stability	Not a "must" for indoor use, "nice-to-have" depending on the customer spec.
Cosmetic quality	Much loose than display film. Need to further confirm.
Thickness	Depends on applications & stiffness requirement to avoid the sagging. Also related to the UL performance. 2mm above for panel light and 1mm above for down light.

Technology Plan	
Who Contributed	Zhe Chen, Steve Sun, Jos Dekkers
Resources Required	Re-graved steel roll for Lab line
Any Resin NPI needed	no
If No NPI Needed what Standard extrusion resin will be used	LUX2614-WH8E490X & EXRL0781
Any EHS Concerns	No
Any RMIs Required	No
Any Long term Testing	No
Any Patent or FTP Issues expected	FTP check done, Patent application filed

Thick Gauge ($\geq 2\text{mm}$)

- Diffuser particles technology

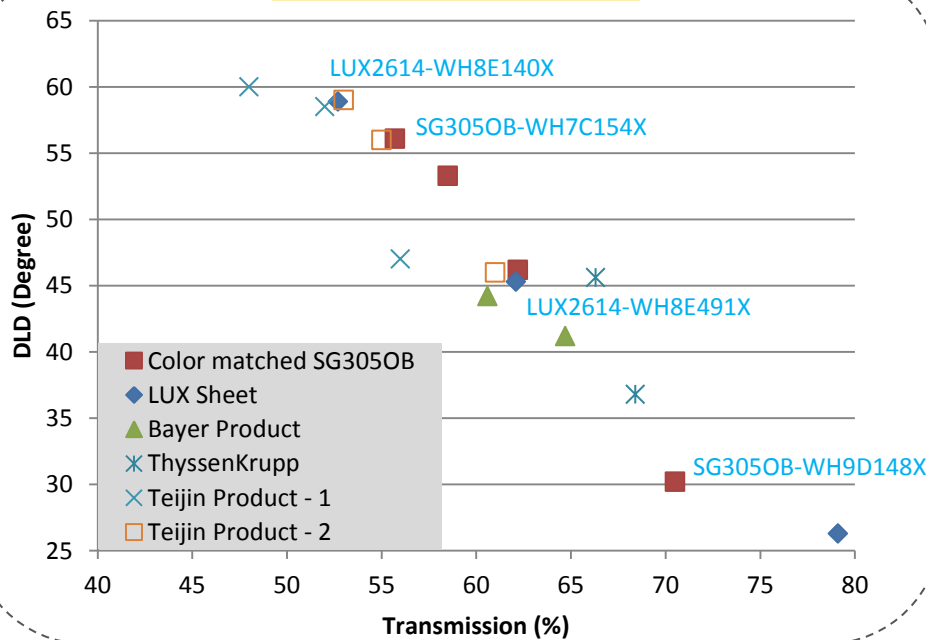
Thin gauge ($< 2\text{mm}$)

- Leverage the synergy btw lens-texture and diffuser particles to achieve best in class light output/hiding power balance.
- Focus on 0.8-1.2mm sheet

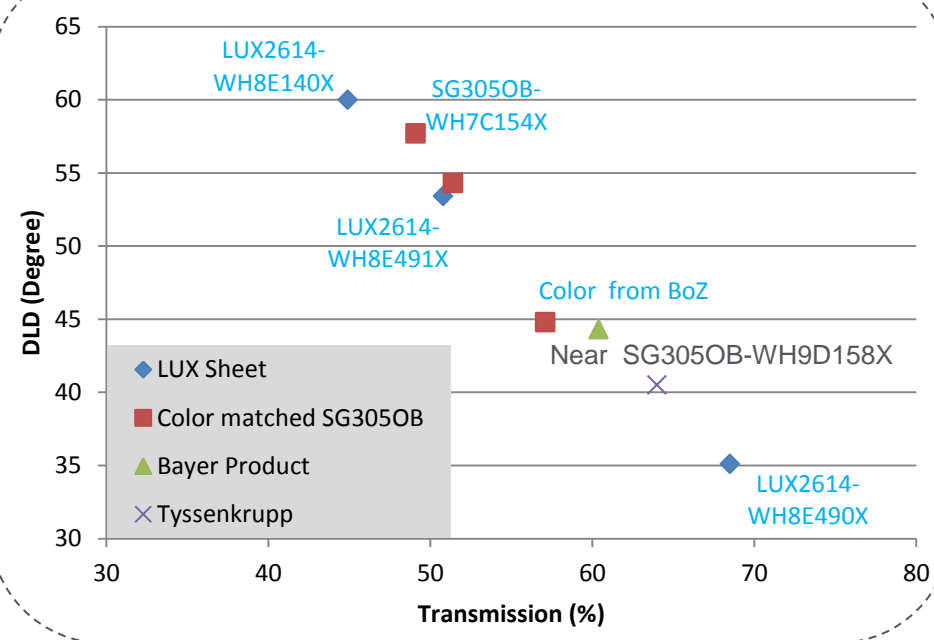
Random texture/diffuser technology for Panel light (gauge > 2mm)

- Requirement: high hiding power (40-60), medium transmission (50-70%)
- it is easier to reach sound hiding power level with only diffuser technology;
- LUX resin with random texture and SG305OB can cover most of the design space for this application.
- **Priority in N. PAC (Low)..** Me-too products, Cost: less competitiveness

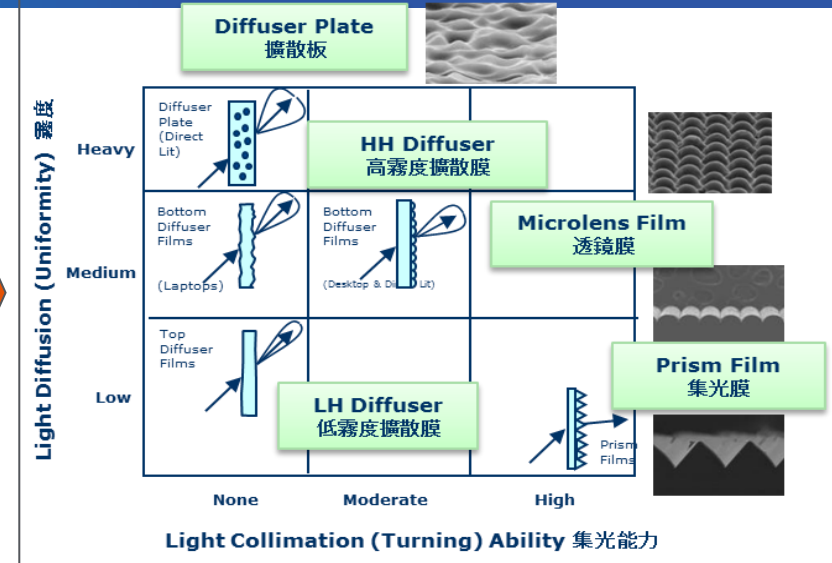
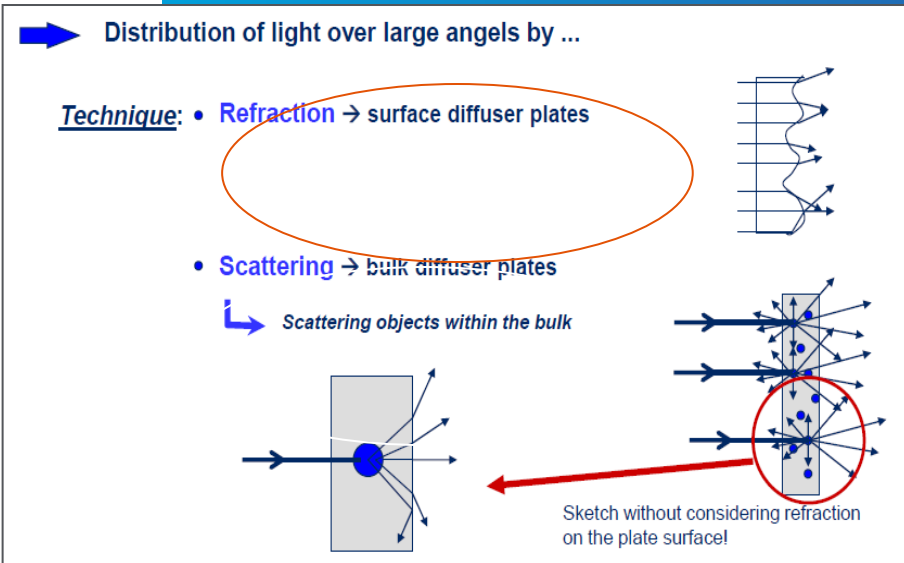
Panel Light at 2mm



Panel Light at 3mm



SABIC-SFS Technology for Thin Gauge LED Sheets



Wide angle scattering of light resulting in good hiding power

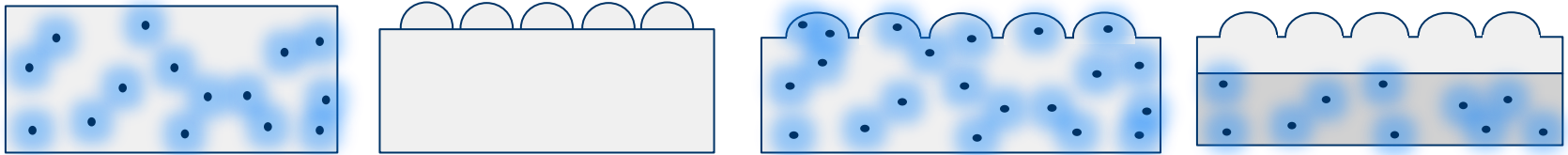
wide angle

LD= 0.44	LT% = 51%		LD= 0.84	LT% = 51%	
		Old additive			New additive

Superior Hiding Power!

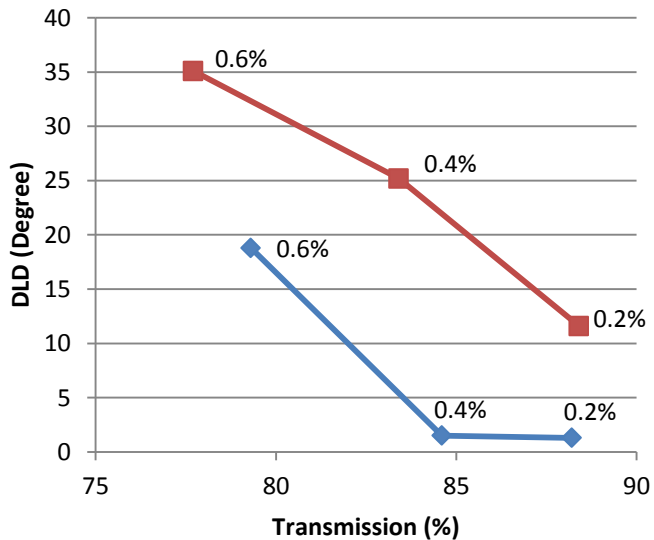
- Synergetic of diffuser & Lens-Texture
- Diffuser...
- Replicate Ratio of texture... depends on various texture, Processing & Sheet Thickness
- Currently can make 1.2mm sheet with fine lens-texture in Nansha
- Target... expand to 1.5mm

Micro-lens/diffuser synergy for Panel light (gauge < 2mm)

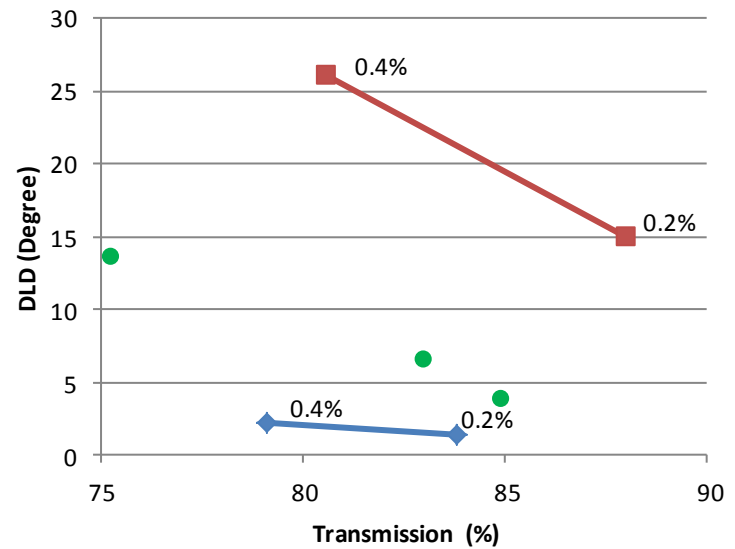


	Diffuser only	Lens only	Diffuser/lens mono	Diffuser/lens Co-ex (lens/diffuser: 87/705)
Trans%.	84.6	91.8	83.4	85.0
DLD	1.5	6.1	25.2	23.1

Down light at 0.8mm



Down light at 1.0mm



Can maintain the synergy up to 1.2 mm thickness

Lab Sample Prepared in CTC

			Trans(%)*	Trans(%)#	DLD (°)
SFS LED Product	0.8mm	Low Hiding Power	78.9	90.8	11.6
		High Hiding Power	77.9	87.1	19.5
	1.0mm	Low Hiding Power	85.2	88.3	11.6
		High Hiding Power	77.7	82.6	25.7
	1.2mm	Low Hiding Power	86.4	87	7.4
		High Hiding Power	79.3	79.7	24.8
Special Grade Fine-tuned for Osram	1.0mm		88.7	90.9	9.9

* Light transmission tested by lighting sample from EDT side to Micro lens side

Light transmission tested by lighting sample from Micro lens side to EDT side

Plan for Mfg Scale-up

Manufacturing Plan	
Who Contributed	Hiker Zhou, Baker Cai
Manufacturing Sites	Nansha
Investment Required	Re-grave an old Steel Roll
EHS concerns	No
Can test for CTQs	Partly
Raw material Handling	Standard
Other	

- Lab run in CTC to scope the lens texture, Processing and diffuse type/loading
- 7 preliminary grades produced in CTC for customer validation
- A steel roll got re-graved with selected texture/Murata for Nansha Plant
- Raws ready for scale-up trial in Dec
- Masking film , placed order.
- Low cost masking film being screened
- Prepare 70 Square meter samples for final testing in Osram, End of Dec
- T3 schedule.. 1Q13

Customer Validation

Customer Information	
Validation Customer	Osram, China
Other Customer	Philips, China
Validation Pole	Pacific
Market	LED
Sample Date Needed	23-Dec
Sample Quantity	50 pcs of 1m*2m, 1.0 thin guage
Commercial Date(T5)	1Q, 2013
Share Shift (Y or N)	N
New Growth (Y or N)	Y
Core Retention (Y or N)	N
Competitor(s)	Bayer, Teijin and local sheet extruders

Focus on Osram, New Model: LXPT MIDI 6
 Performance Ok, waiting for Scale-up samples for final testing
 Commercial order ..1Q13

Check other Models to get more volume

Philips validation – Performance Ok, Cost Pressure

Summary

Thin gauge diffusion sheet with Microlens texture

Overview:

Application: LED Lighting Covers – Downlight

Program Description: Thin diffusion sheet for LED lighting covers through leveraging the synergy btw lens-texture and diffuser particles to achieve the best-in-class light output/hiding power balance.

Validation Customers: Philips, Osram

Competitor: Diffusion sheet with random texture

EVA: 300MT/12Y, 500Mt/13Y, ASP 7.5 \$/kg, CM>30%

P&E: Low/Re-texture a steel roll

CTQ's:

- Thickness 0.8~1.5mm
- High %LT for light cover
- Various hiding power, depending on application
- Uniform Light distribution
- Fast response & short lead time
- FR performance, V2 @0.8mm

Product Portfolio:

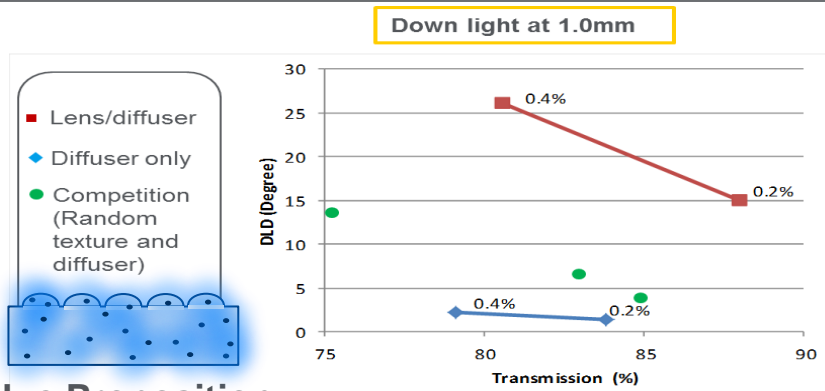
EXSP0900, 7 Grades, 0.8, 1.0 & 1.2mm

Manufacture:

Nansha Site, Line 65



Adobe Acrobat Document



Value Proposition:

- Unique product with synergy btw Lens-texture and Diffuser
- Best hiding power with high light output in thin gauge sheet
- V2 pass, 0.8~1.2mm range
- Local supply

Timeline:



Key Actions/Next Steps:

- Investigate synergic effects btw lens texture and diffuser loading
- CTC Lab run to scope the lens texture and diffuse type/loading
- 7 preliminary grades produced for customer validation
- FTP Check, Patent draft submitted
- Positive feedback from Philips/Osram, Osram order in
- An steel roll got re-graved with selected texture
- Raws ready for scale-up trial in Jan @ NANSHA site
- Pilot production in CTC for Osram final testing..Wk of Dec17

Thick gauge diffusion sheet with UV caplayer

Overview:

Application: LED Lighting Covers – Panel Light

Program Description: Thick diffusion sheet for LED lighting covers, UV protective caplayer with diffuser particles in sheet substrate, random #5 texture one side, **As well as non Textured**

Validation Customers: Philips, Osram

Competitor: Diffusion sheet w/wo random texture

EVA: 700MT/12Y, 1000Mt/13Y, ASP <6\$/kg. CM <20%

P&E: No

Inventory: 2 colors, 2Mts total in Nansha site

CTQ's:

- Thickness >2mm
- High %LT for light cover
- Various hiding power, depending on application
- Uniform Light distribution
- Fast response & short lead time
- FR performance (optional)

Product Portfolio:

SG305OB, WH7C154X & WH9D148X, 2&3mm
Exell D OB , same colors , 2 & 3 mm

Manufacture:

GESPI, Italy –Textured and non textured
India – non textured

Timeline:

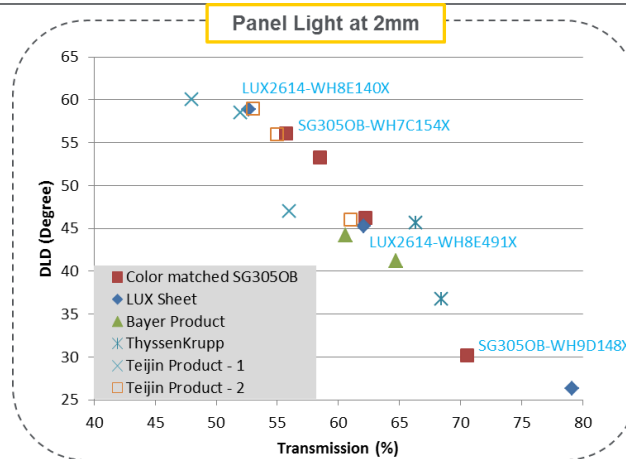
Available now

Key Actions/Next Steps:

- Scope diffuse type/loading in CTC/BOZ
- 2 colors with 2 thickness produced for customer validation
- Small order from Philips
- 2Mts total inventory buildup in Nansha
- **Priority in N. PAC (Low)..** Me-too products, Cost/Tech: less competitiveness

Value Pros:

- Good hiding power with high light output
- UV caplayer for weathering



Diffusion Sheet Developed in Baroda/Klang: Under Evaluation

Overview:

Application: LED Lighting Covers – Panel Light ; LED sign

Program Description: Diffusion sheet based on LUX resin; Polished non textured as well as random 3 texture one side ; Possible UV cap layer for thick sheet > 2 mm at India .

Validation Customers: Philips ,Wipro ,Bajaj ,Malaysia and India customers

Competitor: Diffusion sheet w/wo random texture

P&E: No

Value Pros:

- High LT and good hiding power
- Low duty ,low cost for local market (4 % to 10 % saving)

CTQ's:

- High %LT for light cover
- Various hiding power, depending on application
- Uniform Light distribution
- Fast response & short lead time
- FR performance (optional)

Product Portfolio:

1 mm to 3 mm thick extruded sheets /Films

Manufacture:

Klang ,Malaysia < 1.5 mm.. Polished as well as textured
Baroda ,India :Only polished 1.2 mm to 3 mm

Timeline:

Trial stage ; Test /evaluation to be conducted on LT and Diffusion performance at CTC

Decision to go /no go for LED light cover by Jan 12
Targeted for Malaysia and India customers owing to tax benefits v/s imports from EU /Nansha

Key Actions/Next Steps:

- Trails in 2 nd week Dec
- One color
- Non textured as well as textured
- send to CTC for comparing performance
- No inventory – all as MTO
- Assess market for LED sign