



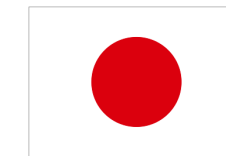
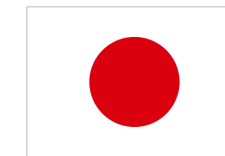
Activities at IJCLab over Autumn/Winter 2022/23

With focus on understanding the delamination of sensors

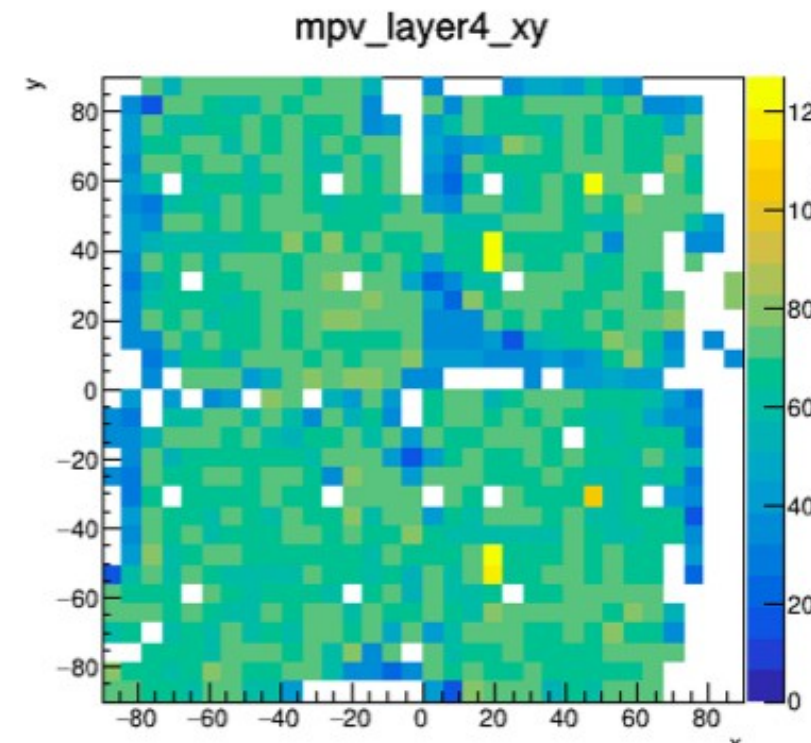
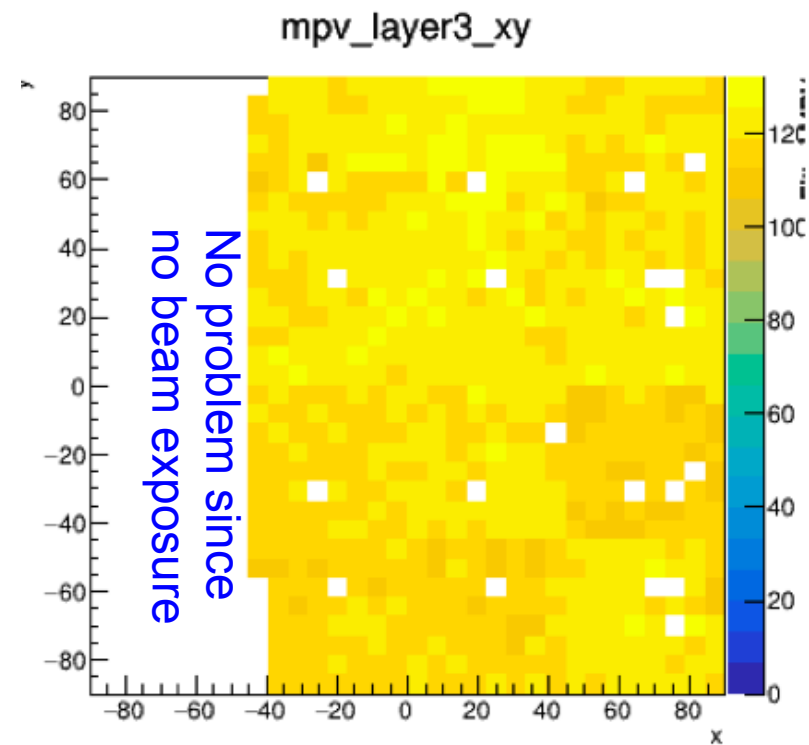
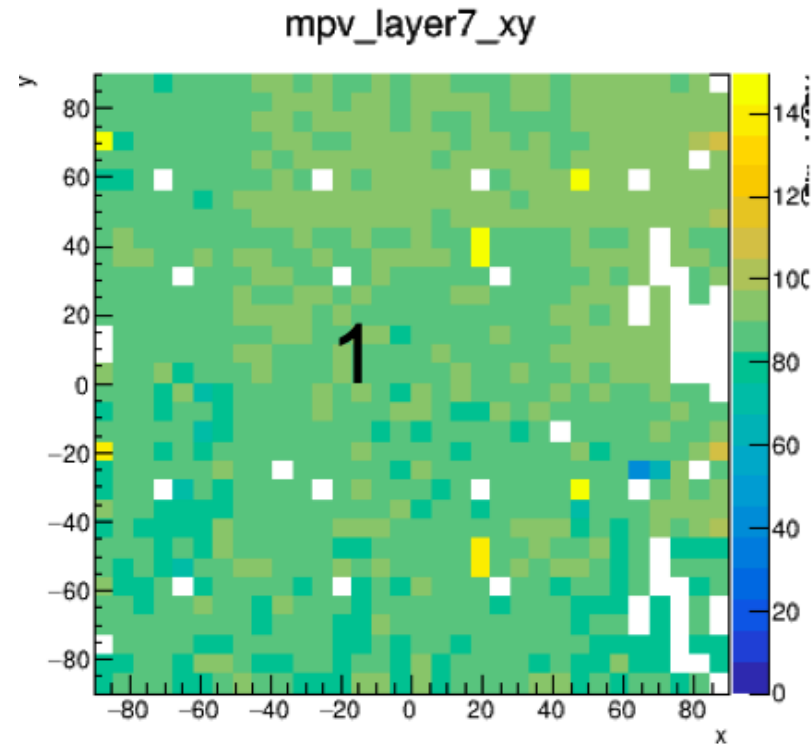
Roman Pöschl



On behalf of the SiW ECAL Groups in CALICE:



CALICE Meeting – March 2023



- We have good layers ...
 - Homogeneous response to MIPs over layer surface
 - > 90% efficiency for MIPs
 - Here white cells are masked cells due to PCB routing
 - understood and will be corrected

... and not so good layers

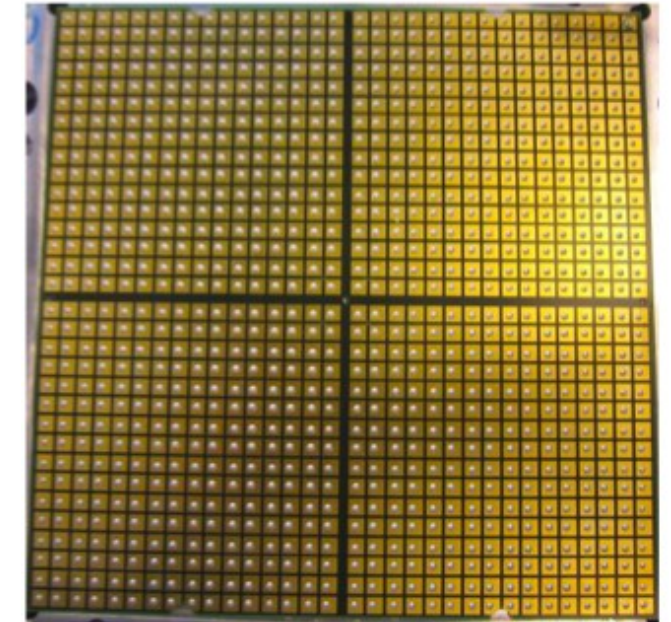
- Inhomogeneous response to MIPs
 - Partially even no response at all, in particular at the wafer boundaries
 - Not seen in 2017, degradation already observed during 2018/19
 - Upon visual inspection delamination could be seen by eye
- Since Summer 2022 access to the different stages of the ASICs
 - => analogue probes, major debugging tool

- **Metrology and PCB Deformation**

- Setup of a device to measure the flatness of the PCB at different stages
- PCBs will be out into cabling machine and dimensions will be
- monitored before and afterwards

- **Glue – Alternative agents and procedures**

- After discussion with Astronomy Institute of Paris and Epotek
- Test glue of type H20E as alternative to Epotek J2189
 - Should have higher mechanical stability
- Use EPOTEK 301-2 as underfill for mechanical stabilisation (proposal of Epotek)
 - This underfill has low viscosity that ensures mechanical stability by capillary effect
 - See datasheet in backup
- Alternative proposal EPOTEK 353ND-T
 - Epoxy for gluing electrical component, could be used to stabilise glued sensor at sensor boundaries
 - Data sheet in backup

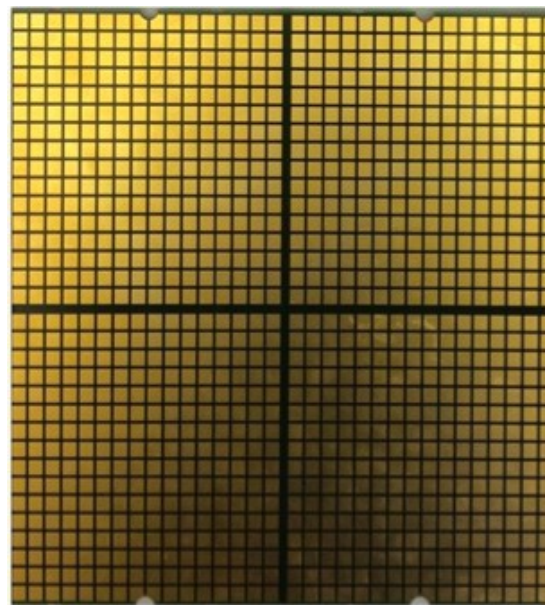


- **Pull tests**

- IJCLab will prepare pull tests in order to get a quantitative picture of the mechanical stability of the glue
- Maybe in combination with C2N – A CNRS Institute specialised for materials

IJCLab Cabling workshop

Uncabled PCB



Measurement before cabling

Sérigraphie



La sérigraphie consiste à déposer de la pâte à braser sur toutes les surfaces recevant des pattes de composants. Pour cela, il est nécessaire d'utiliser un masque de sérigraphie réalisé en sous-traitance.

Placement automatique



Machine de placement automatique MyData permettant la pose des composants CMS. Elle permet actuellement la pose de boîtiers de dimension jusqu'à 402.

Refusion à phase vapeur

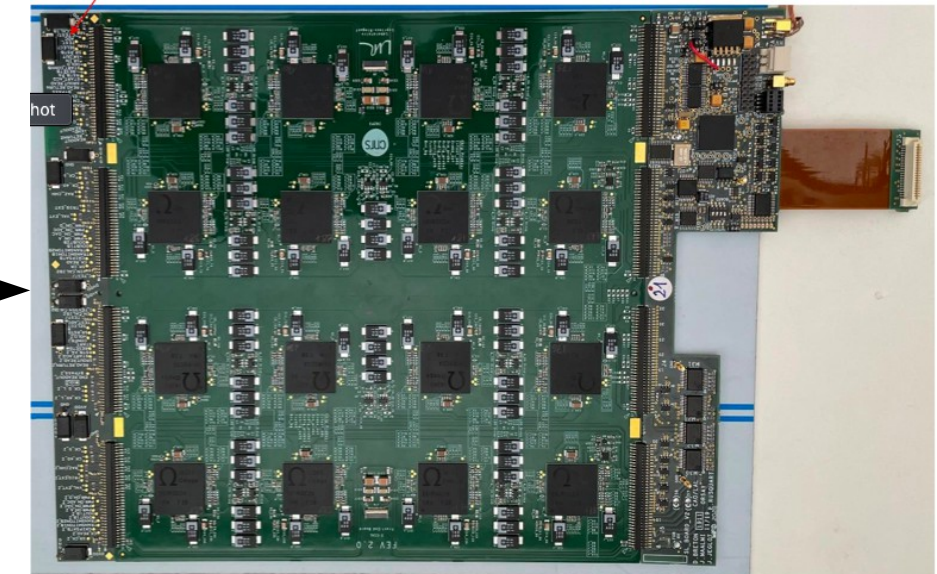


Heat exposure

Nettoyage



Cabled PCB



Measurement after cabling



At IJCLab we can control and measure the PCB before and after cabling for deformations
 Adrian has measured 300um deformation (see talk tomorrow), don't know where it came from

- **Setting up a metrology chain**
 - Using tridim machine of mechanical workshop of IJCLab
 - Also access to optical profilometer used by ATLAS ITK and HGDT,
 - However, MicroVu Vertex 261 too small for our purposes (MicroVu Vertex 342 would have been ideal)
 - May have to construct an appropriate vacuum table to monitor deformation right before gluing
- **Study proposed epoxies and decide whether they will help us**
 - Setting up of pull tests
- **Setting up of Logistics chain**
 - Gluing will be done outside of IJCLab (most likely IFIC/Spain)
 - Need to set up sending and reception tests on both sides
 - Need to investigate for proper packaging
 - Experience from CMS may help here, Si modules are shipped across the globe
- **Documentation will be essential**
- **Should take the opportunity of the production of ASUs based on FEV2.1 for a complete Revision of assembly chain**
 - Not all was bad in the past but we suffered from production of few boards spanned over many years
 - Loss of focus and expertise
- **At IJCLab April will become the month for (re) kicking-off action after a phase of thinking**

Backup



EPO-TEK® 301-2

Technical Data Sheet
For Reference Only
Optically Transparent Epoxy

Date: February 2021
Rev: XVIII
No. of Components: Two
Mix Ratio by Weight: 100 : 35
Specific Gravity: Part A: 1.15 Part B: 0.95
Pot Life: 8 Hours
Shelf Life- Bulk: One year at room temperature
Shelf Life- Syringe: Six months at -40°C

Recommended Cure: 80°C / 3 Hours
Minimum Alternative Cure(s):
23°C / 48 Hours
May not achieve performance properties listed below

NOTES:

- Container(s) should be kept closed when not in use.
- Filled systems should be stirred thoroughly before mixing and prior to use.
- Performance properties (rheology, conductivity, others) of the product may vary from those stated on the data sheet when bi-pak/syringe packaging or post-processing of any kind is performed. Epoxy's warranties shall not apply to any products that have been reprocessed or repackaged from Epoxy's delivered status/container into any other containers of any kind, including but not limited to syringes, bi-paks, cartridges, pouches, tubes, capsules, films or other packages.
- If product crystallizes in storage, place container in warm oven until crystallization disappears. Please refer to Tech Tip #7 on website.

Product Description: EPO-TEK® 301-2 is a two component optical and semiconductor grade epoxy resin with low viscosity, long pot-life and good handling characteristics.

Typical Properties: Cure condition: 80°C / 3 Hours Different batches, conditions & applications yield differing results.
Data below is not guaranteed. To be used as a guide only, not as a specification. * denotes test on lot acceptance basis

PHYSICAL PROPERTIES:		
* Color (before cure):	Part A: Clear/Colorless	Part B: Clear/Colorless
* Consistency:	Pourable liquid	
* Viscosity (23°C) @ 100 rpm:	225 - 425	cPs
Thixotropic Index:	N/A	
* Glass Transition Temp:	≥ 80	°C (Dynamic Cure: 20-200°C/ISO 25 Min; Ramp -10-200°C @20°C/Min)
Coefficient of Thermal Expansion (CTE):	Below Tg:	61 x 10 ⁻⁶ in/in°C
	Above Tg:	180 x 10 ⁻⁶ in/in°C
Shore D Hardness:	80	
Lap Shear @ 23°C:	> 2,000	psi
Die Shear @ 23°C:	≥ 15	Kg 5,334 psi
Degradation Temp:	360 °C	
Weight Loss:	@ 200°C:	0.01 %
	@ 250°C:	0.46 %
	@ 300°C:	2.19 %
Suggested Operating Temperature:	< 300 °C (Intermittent)	
Storage Modulus:	432,279 psi	
Ion Content:	Cl ⁻ :	61 ppm
	NH ₄ ⁺ :	ND
Particle Size:	Na ⁺ :	104 ppm
	K ⁺ :	ND
		ND
		N/A

ELECTRICAL AND THERMAL PROPERTIES:		
Thermal Conductivity:	N/A	
Volume Resistivity @ 23°C:	≥ 2 x 10 ¹²	Ohm-cm
Dielectric Constant (1KHz):	3.80	
Dissipation Factor (1KHz):	0.012	

OPTICAL PROPERTIES @ 23°C:		
Spectral Transmission:	≥ 94% @ 320	nm
	≥ 99% @ 400-1,200	nm
	≥ 98% @ 1,200-1,600	nm
Refractive Index:	1.5318 @ 589	nm

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www.epotek.com

A Meridian Adhesives Group Company



EPO-TEK® 301-2

Technical Data Sheet
For Reference Only
Optically Transparent Epoxy

EPO-TEK® 301-2 Advantages & Suggested Application Notes:

- Suggested for LCD optical lamination and sealing of glass plates. The product can resist yellowing over 17 days of continuous UV light exposure. Suitable for LED encapsulation.
- Ease of use: potting and casting, encapsulation and adhesive.
- Semiconductor applications: underfill for flip chips, glob top encapsulation over wire bonds, spin coating at wafer level including wafer level packaging.
- Compliant adhesive that will be resistant to impact or vibrations. Low stress adhesive for bonding optics inside OEM / Scientific instruments.
- Fiber optic adhesive: bundling fibers, terminating fiber into ferrule, adhesive for mounting optics inside fiber components, bonding glass cover slip over V-groove; spectral transmission of visible and IR light.
- Adhesion to glass, quartz, metals, wood and most plastics is very good.
- May also be used for impregnating wooden or porous objects for artifact restoration.
- NASA approved, low outgassing epoxy – <http://outgassing.nasa.gov/>

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EPO-TEK® 353ND-T
Technical Data Sheet
For Reference Only
High Temperature Thixotropic Epoxy

Date: June 2022
Rev: XI
No. of Components: Two
Mix Ratio by Weight: 10 : 1
Specific Gravity: Part A: 1.12 Part B: 1.02
Pot Life: 3 Hours
Shelf Life- Bulk: One year at room temperature
Shelf Life- Syringe: Six months at -40°C

Recommended Cure: 150°C / 1 Hour
Minimum Alternative Cure(s):
May not achieve performance properties listed below
150°C / 1 Minute
120°C / 5 Minutes
100°C / 10 Minutes

NOTES:

- Container(s) should be kept closed when not in use.
- Filled systems should be stirred thoroughly before mixing and prior to use.
- Performance properties (rheology, conductivity, others) of the product may vary from those stated on the data sheet when bi-pak/syringe packaging or post-processing of any kind is performed. Epoxy's warranties shall not apply to any products that have been reprocessed or repackaged from Epoxy's delivered status/container into any other containers of any kind, including but not limited to syringes, bi-paks, cartridges, pouches, tubes, capsules, films or other packages.
- Syringe packaging will impact initial viscosity and effective pot life, potentially beyond stated parameters.
- **TOTAL MASS SHOULD NOT EXCEED 25 GRAMS**

Product Description: EPO-TEK® 353ND-T is a two component, highly thixotropic epoxy with non-flowing properties and high temperature resistance.

Typical Properties: Cure condition: 150°C / 1 Hour Different batches, conditions & applications yield differing results.
Data below is not guaranteed. To be used as a guide only, not as a specification. * denotes test on lot acceptance basis

PHYSICAL PROPERTIES:			
* Color (before cure):	Part A: Tan	Part B: Amber	
* Consistency:	Smooth thixotropic paste		
* Viscosity (23°C) @ 20 rpm:	9,000 - 15,000	cPs	
Thixotropic Index:	3.8		
* Glass Transition Temp:	≥ 90	°C (Dynamic Cure: 20-200°C/150 25 Min; Ramp -10-200°C @20°C/Min)	
Coefficient of Thermal Expansion (CTE):			
	Below Tg:	43	x 10 ⁻⁶ in/in°C
	Above Tg:	231	x 10 ⁻⁶ in/in°C
Shore D Hardness:	80		
Lap Shear @ 23°C:	1,953	psi	
Die Shear @ 23°C:	≥ 15	Kg	5,334 psi
Degradation Temp:	409	°C	
Weight Loss:			
	@ 200°C:	0.53	%
	@ 250°C:	1.22	%
	@ 300°C:	2.37	%
Suggested Operating Temperature:	< 325	°C (Intermittent)	
Storage Modulus:	559,120	psi	
Ion Content:	Cl ⁻ : 471 ppm	Na ⁺ : 143 ppm	
	NH ₄ ⁺ : 400 ppm	K ⁺ : 15 ppm	
* Particle Size:	99% ≤ 20	microns	
ELECTRICAL AND THERMAL PROPERTIES:			
Thermal Conductivity:	N/A		
Volume Resistivity @ 23°C:	≥ 4 x 10 ¹²	Ohm-cm	
Dielectric Constant (1KHz):	3.21		
Dissipation Factor (1KHz):	0.003		

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EPO-TEK® 353ND-T
Technical Data Sheet
For Reference Only
High Temperature Thixotropic Epoxy

EPO-TEK® 353ND-T Advantages & Suggested Application Notes:

- Suitable for fiber optic and circuit assembly applications.
- Recommended for bonding metals, glass, ceramics and many types of plastic.
- High temperature adhesive for hybrids and medical devices; it can resist within the 300°C range for long periods of time.
- Circuit assembly applications; staking SMD's to PCB, bonding ferrite cores together in copper coil windings, inductor coils and power devices; suitable for COB glob top DAM material.
- Alternative product versions available with distinct viscosity ranges - contact Technical Services at techserv@epotek.com for best recommendation.
- Can be applied by screen printing, spatula, hand held or automatic dispensing equipment.
- Amber color change when properly cured for easy visual ID and inspection.

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