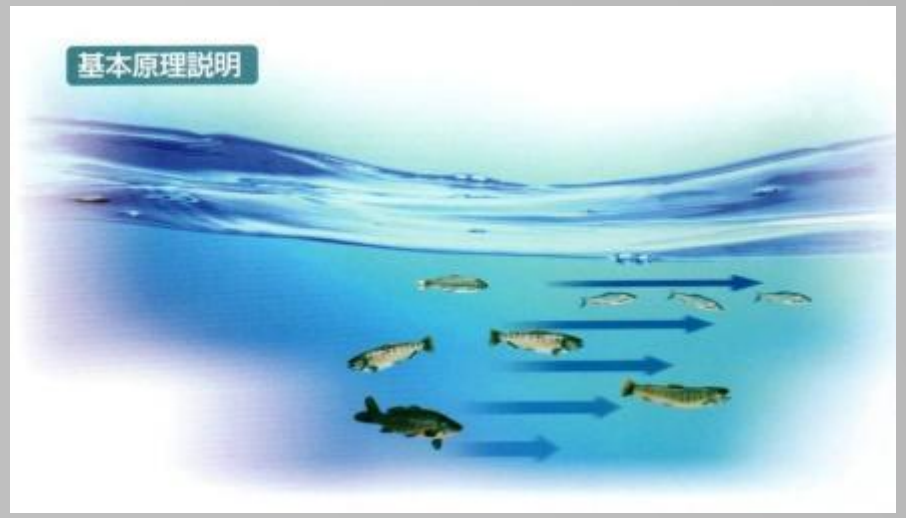
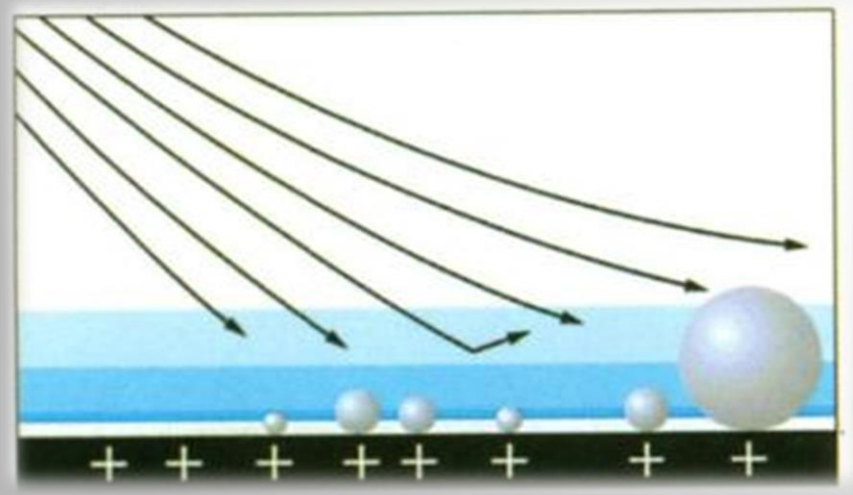
立百邑有限公司
LiBaiYi Co., Ltd.

乾式超聲波清潔
Dry Ultrasonic Clean簡介

為何要使用超聲波清潔?

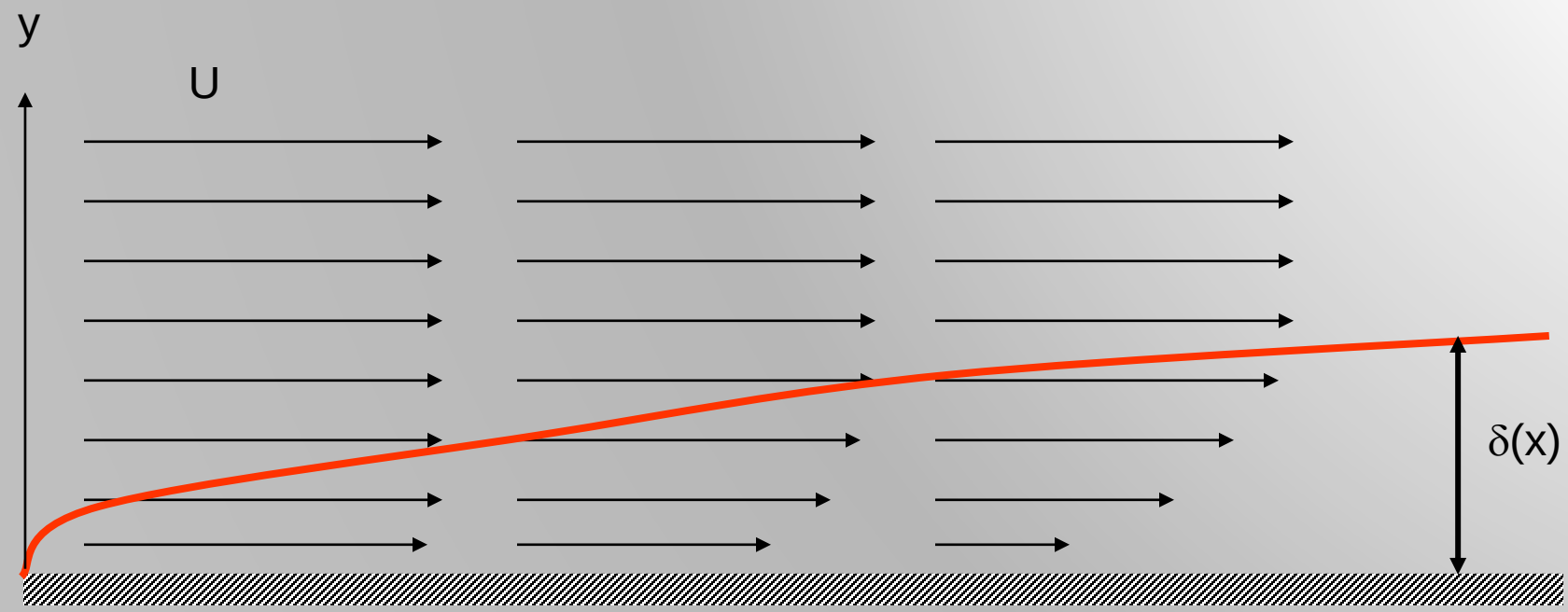
流體邊界層效應





氣體於固體表面上流動，不管流速多快，於固體表面一定會有一流速緩慢的層流層(Laminar flow)，就像海洋，海水表面波濤洶湧，但海面底下的魚不受影響。此流速緩慢的層流層使小顆粒particle（<20um）無法有效被去除。

邊界層厚度(Boundary layer thickness)



U is the free-stream velocity

$\delta(x)$ is the boundary layer thickness when u(y) ==0.99U

清潔設備的演進與趨勢

Wet Cleaning

- Remove of oil and particle
- Enhance bonding yield
- A large amount of solvent
- Environment pollution
- Solvent residue

- In line process
- High through put

Plasma Dry Cleaning

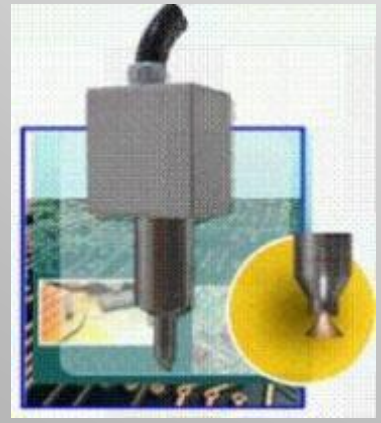
- Reduce need for toxic solvents
- Reduced environmental pollution
- Reduced worker exposure
- Safe end products
- Cost-effective process
- Vacuum envrionment
- High cost

Dry Atmospheric Cleaning

AP Plasma Cleaning

Dry Ultrasonic Cleaning

- In-Line processes
- Low cost
- Low running cost
- No limits of surface area
- Cost-effective process
- Large area
- High cleaning speed

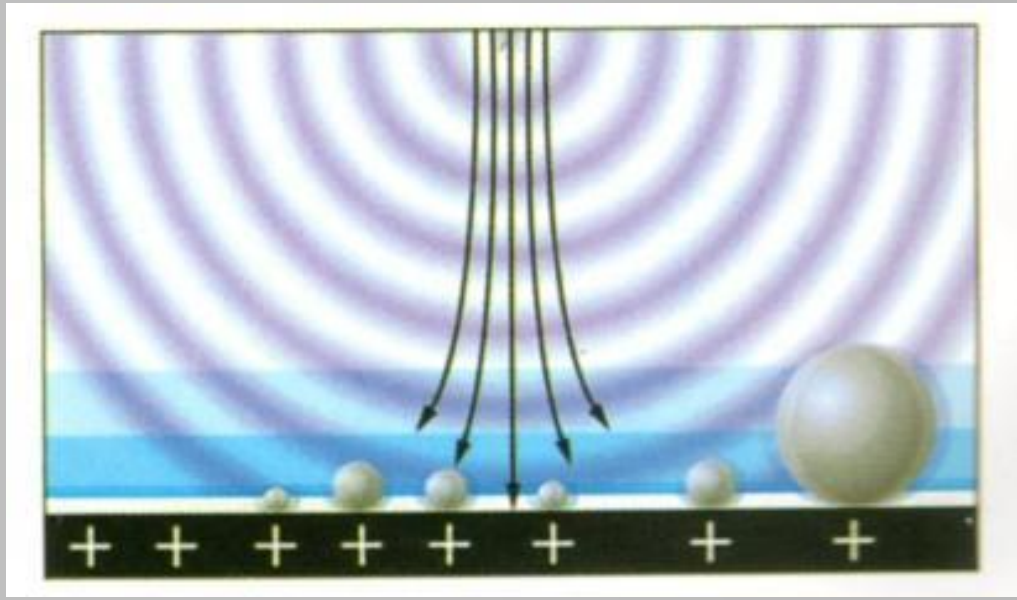


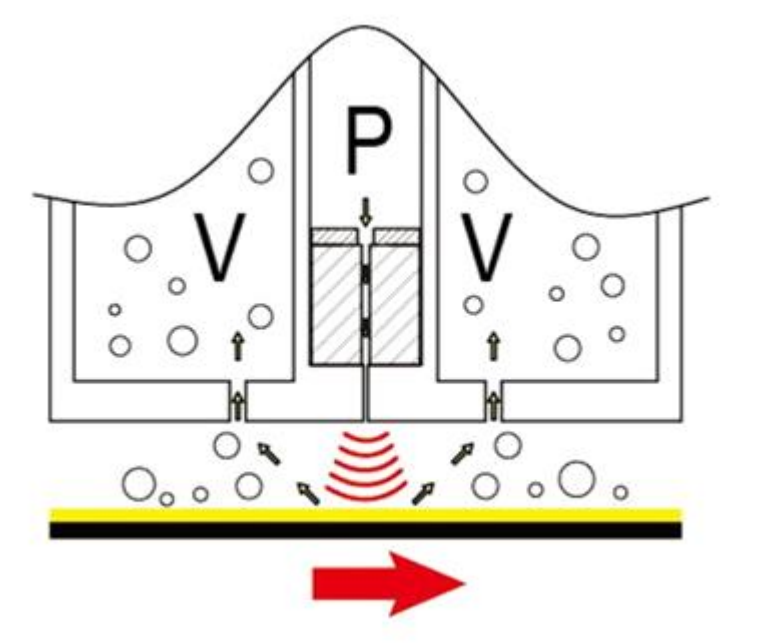
Particle汙染機制

※試片因環境在製程及運送過程，產生粉塵污染，造成後續製程良率不佳

常見的污染機制可細分為6大類，
(1)~(4)可用DUC去除
(3)~(5)可用AP Plasma去除
(6)僅能使用相對應化學品去除

Dry Ultrasonic Clean 原理說明





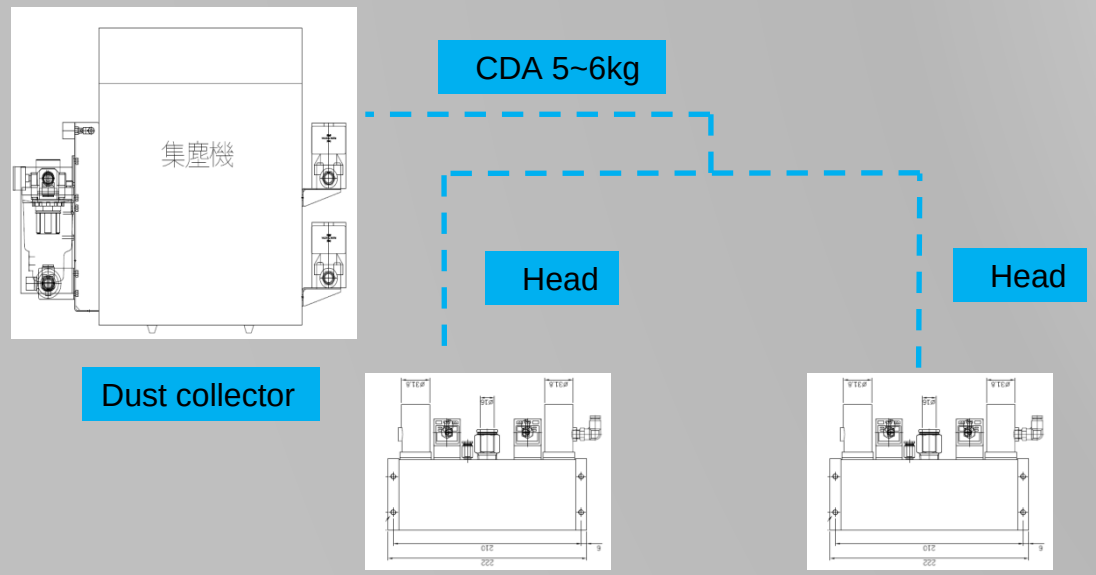
超聲波清潔的原理是藉由超聲波突破邊界層，將振動能量傳遞至粉塵，進而與基板分離後，由兩側的排氣口吸除

Dry Ultrasonic Clean 實體照片與介紹

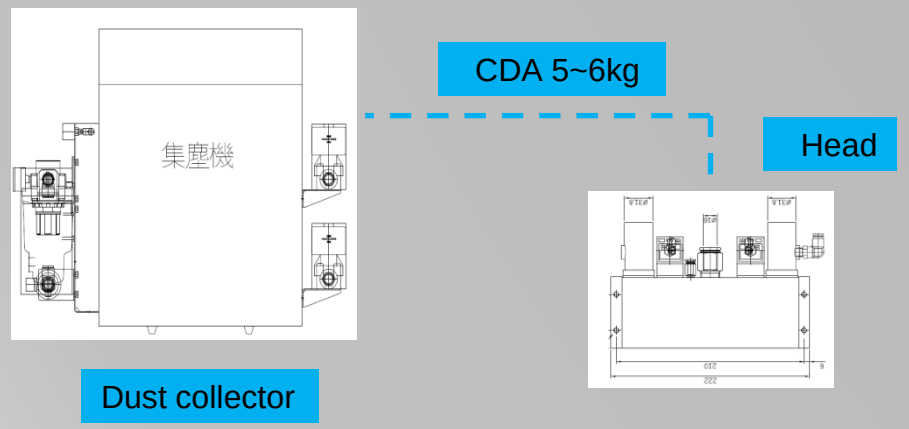
- 3um particle 去除率高達98%以上。（on glass ）
- 免維修、低損耗、空間易配置。
- 氣流平衡設計，Particle不外流
- 採用 VPV / PV超音波高壓振盪風刀，以具超音波效能之強力風刀，去除物件邊界層之Particle，再由兩側高壓集塵，產生真空效應清除粉塵
- 非接觸式除塵，無損傷材質疑慮。
- 搭配日本集塵機及高效過濾設備，品質穩定，並達到極高標準之清潔效果
- 超音波Head達到業界最薄50mm，並可配合客戶設備空間，客製化設計。

Dry Ultrasonic Clean 架構說明

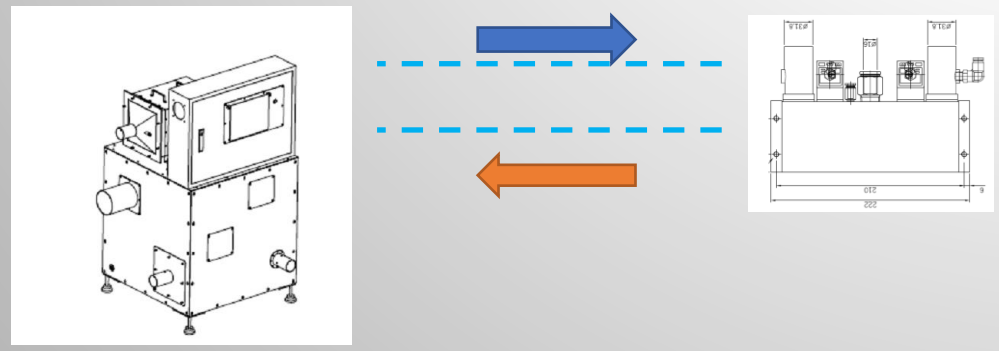
CDA TYPE 1對2(適用無塵室)



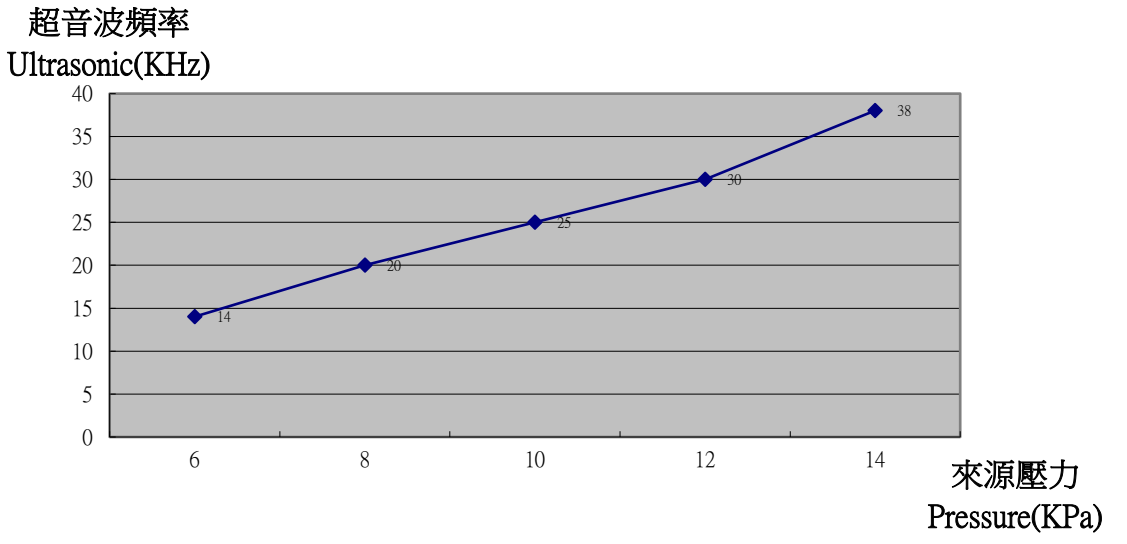
CDA TYPE 1對1(適用無塵室)

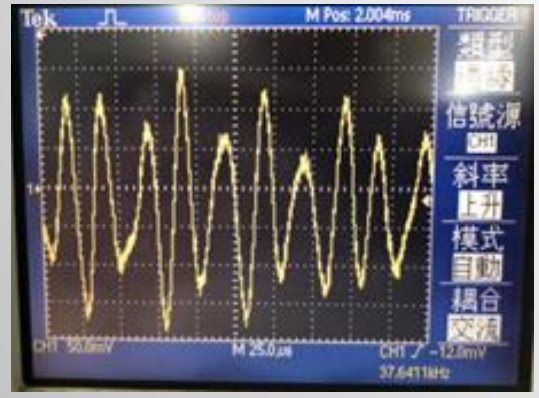


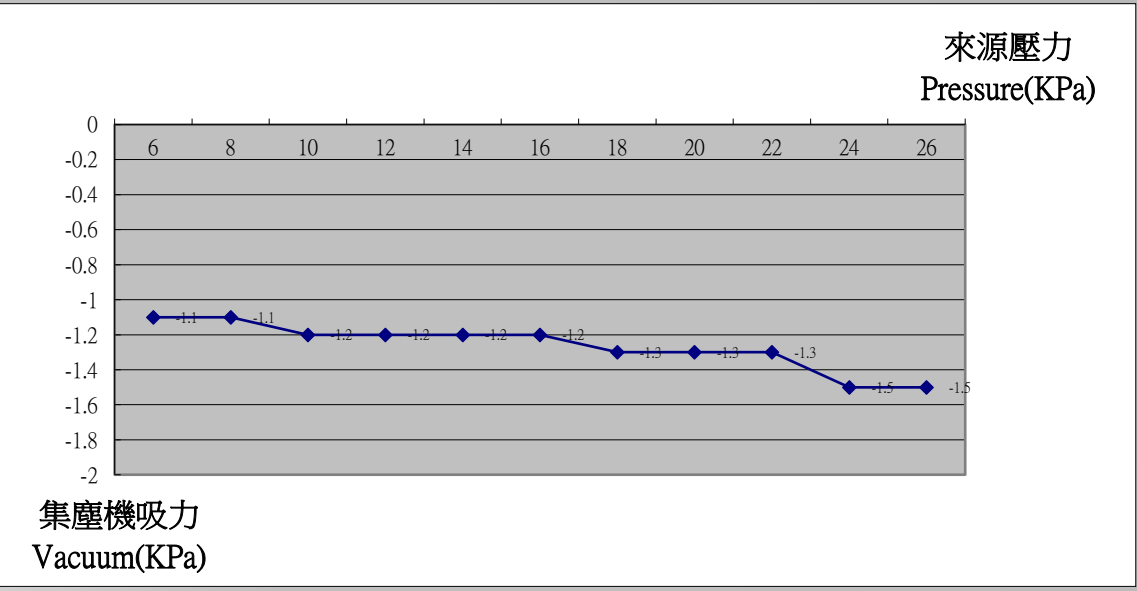
Blower TYPE 1對1



Dry Ultrasonic Clean 壓力與頻率







測試參數：
型號：DUC-300C
Head尺寸(有效寬度)：300mm
Head至產品高度(gap)：2mm
集塵機品牌：CHIKO (JP)

Dry Ultrasonic Clean 測試報告

Test 1 Al at 2mm GAP on glass

No.	1 (98.98%)	2 (98.78%)	3 (99.22%)	4 (98.46%)	5 (98.11%)
USC 前 (ea)	0	0	0	0	0.1
异物涂布 (ea)	138	164	3240	98	106
USC 后 (ea)	1.4	2	< 25	1.5	2.1

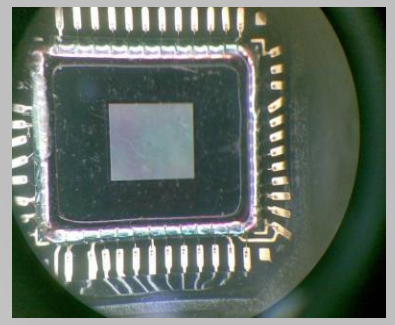
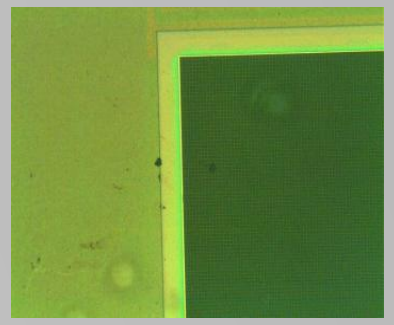
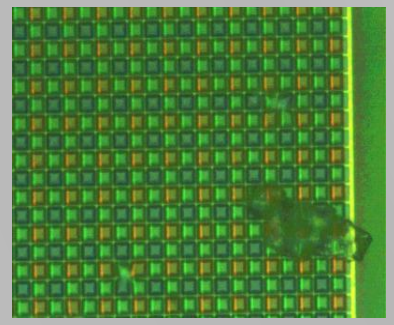
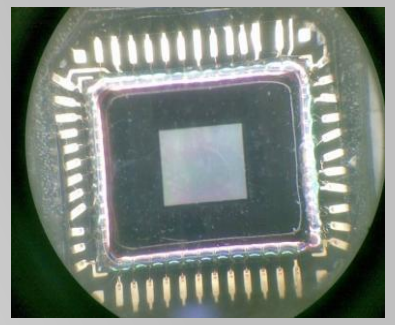
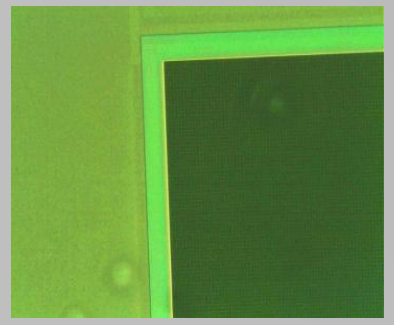
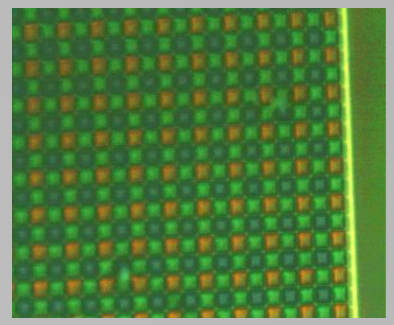
Test 2 SiO2 at 2mm GAP on glass

No.	1 (99.80%)	2 (99.81%)	3 (99.61%)	4 (99.92%)	5 (99.92%)
USC 前 (ea)	0	0	0	0	0
异物涂布 (ea)	518	323	1296	241	324
USC 后 (ea)	1.0	0.6	< 5	0.2	0.2

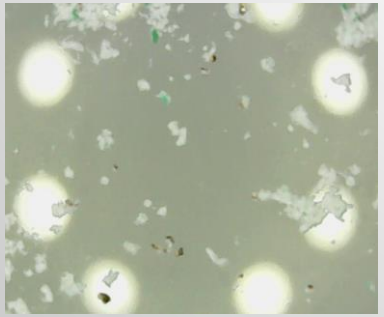
Dry Ultrasonic Clean 測試報告

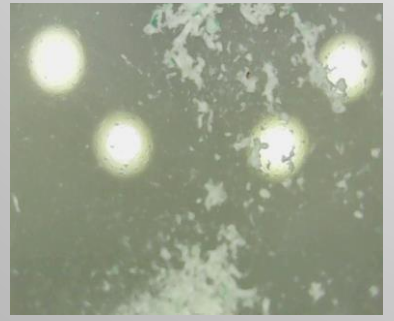
Test 3 SiO2 at 2mm GAP on CMOS
※Clean and no Damage

Test 4 SiO2 at 2mm GAP on Lens

DUC Clean (60X)　DUC clean (100X)　DUC Clean (500X)

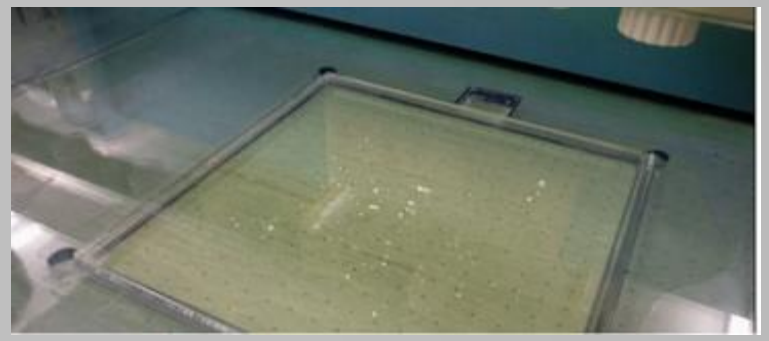




Before Particle　After Particle　After DUC

Dry Ultrasonic Clean 測試報告

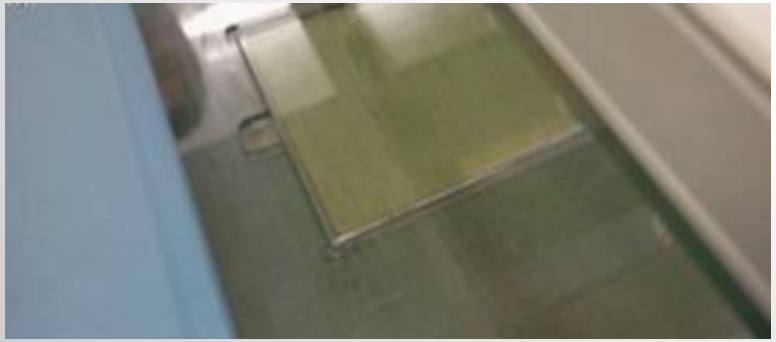
Test 5 Wafter Mask Clean

※High Light Detection, 3um Particle(no adhesion) 99% Clean



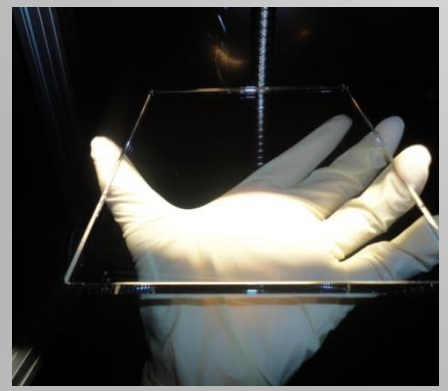
Before Particle

DUC clean



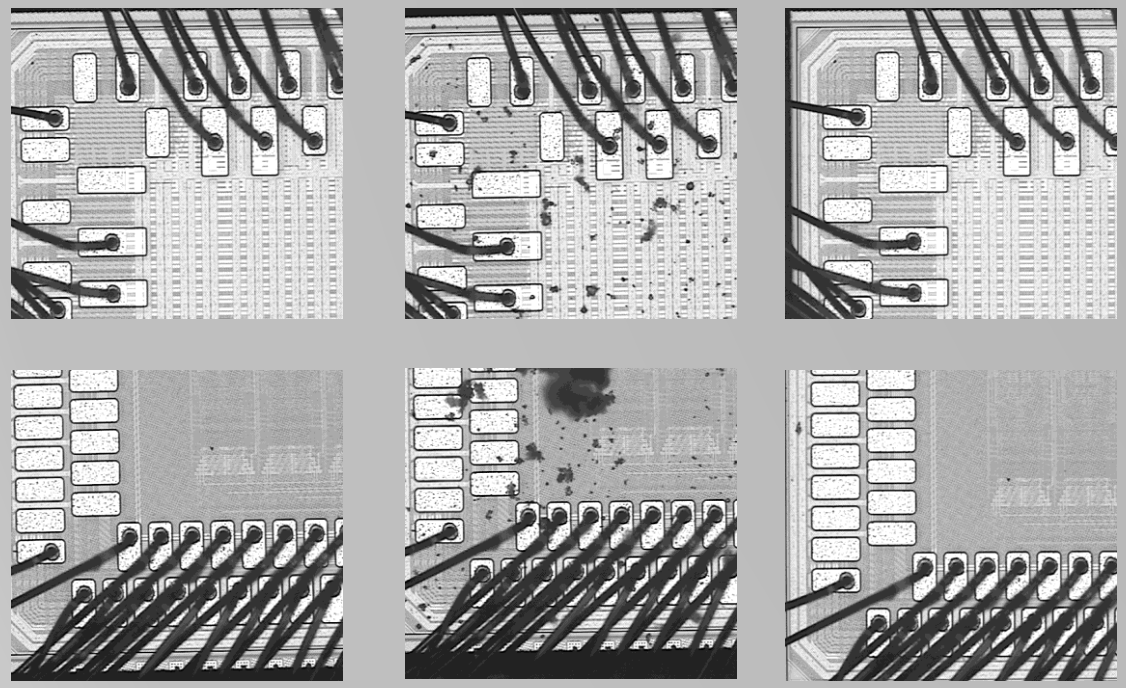
After DUC

High Light detection



After Clean

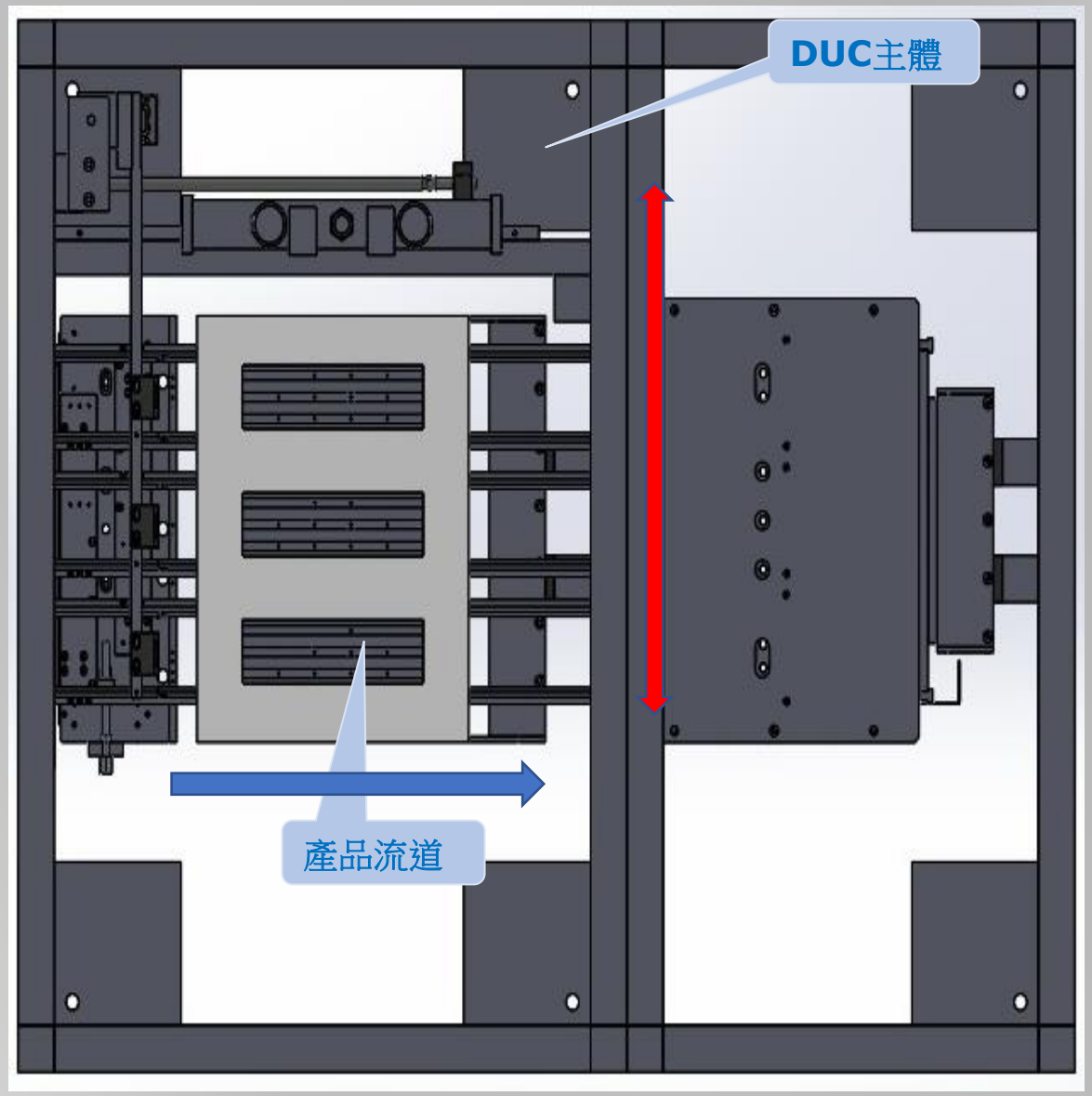
Test 6 SiO2 at 2mm GAP on Lead Frame
※10um Particle 85% Clean + and No Wire Sag

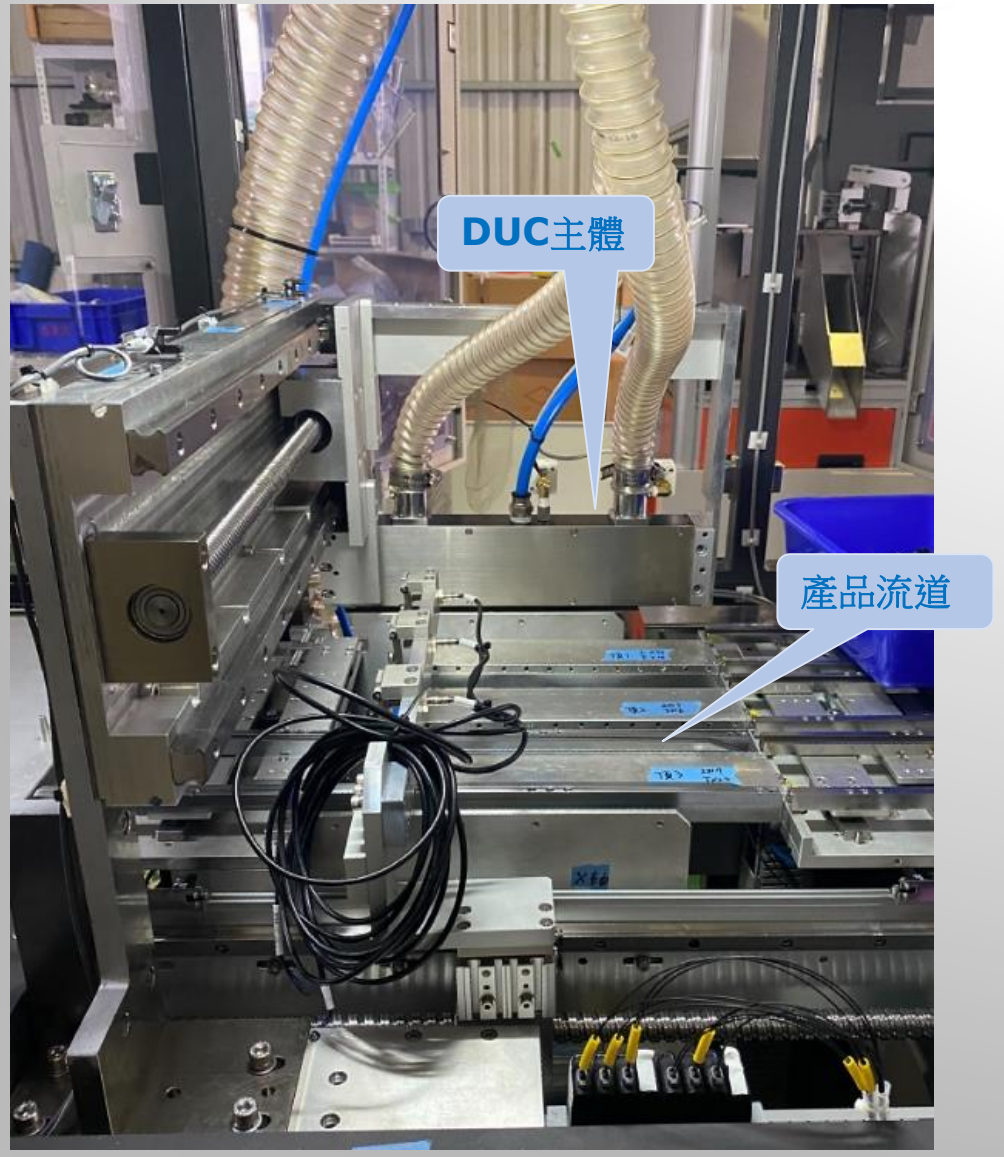


Before Particle After Particle After DUC

No Wire sag

Dry Ultrasonic Clean 架設範例 (Plasma後)





Dry Ultrasonic Clean 測試報告

Dry Ultrasonic Clean test （5kg 壓力吹出 ）

Particle size	Particle count (as is)	Particle count (to be ）
>80	5	0
>70	2	0
>60	15	0
>50	22	0
>40	16	2
>30	55	6
>20	168	15
>10	292	23
Total	575	78
Clear rate %	92%	

Air shower test （5kg 壓力吹出 ）

Particle size	Particle count (as is)	Particle count (to be ）
>80	8	0
>70	5	1
>60	10	0
>50	16	6
>40	11	6
>30	43	35
>20	124	85
>10	268	142
Total	485	78
Clear rate %	44.3%	

DOE Base 4x13 BGA dummy die test result / 風壓條件 5kg
Air shower 吹除效果與 DUC 清潔效果可看出模組功能清潔效益 （ 以40um 以下最為明顯 ）

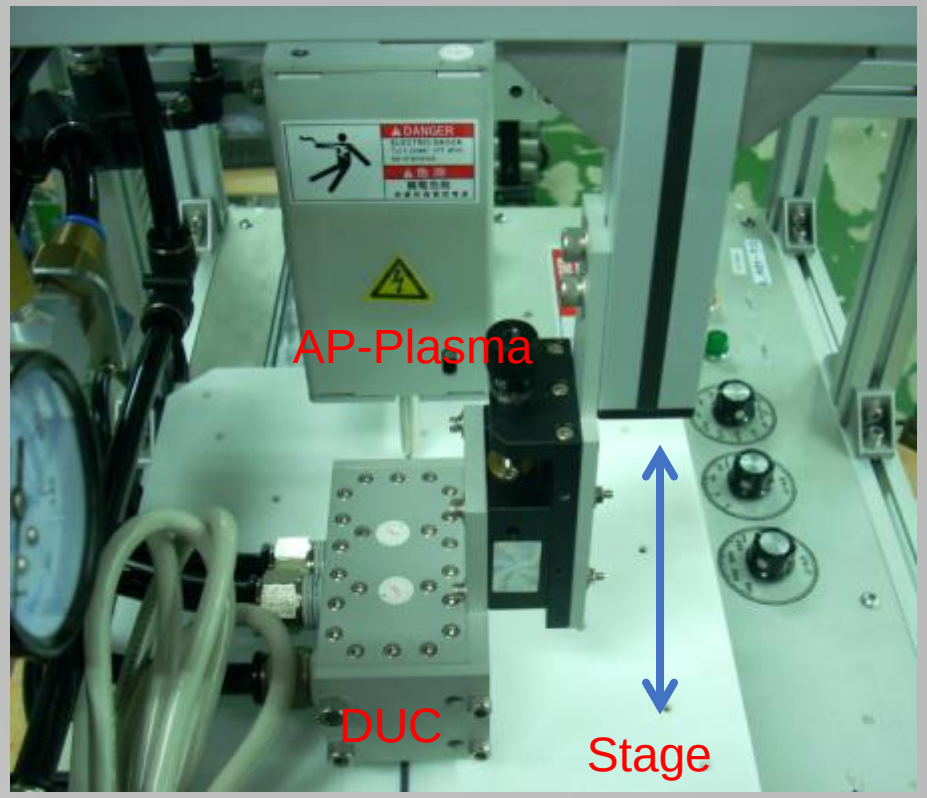
DOE 範本

LOT NO	25XXXX-B001
Package Type	
Device Name	
Lot size	
Lot start time	
Lot completed time	

									1
									2
									3
									4

Particle size	Particle count (as is)	Particle count (to be ）
>80		
>70		
>60		
>50		
>40		
>30		
>20		
>10		
Total		
Clear rate %		

Dry Clean System原理說明
(Dry Ultrasonic Clean and Atmospheric Plasma)



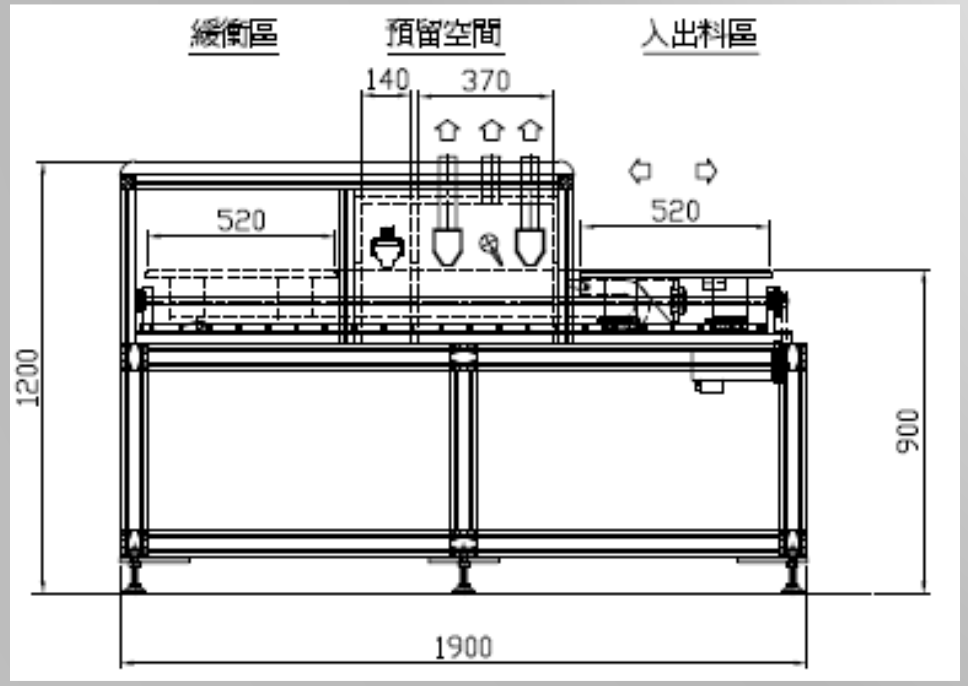
AP-Plasma

DUC system

整合DUC及AP-Plasma進行非接觸式清潔的單機系統，可支援UD/LUD，達至非接觸式完全清潔，將頑固的Particle及Organic Pollutant單機清潔完畢

Dry Clean System實績案例
(Dry Ultrasonic Clean and Atmospheric Plasma)

AP-Plasma + DUC system
off-line/in-line solution



整合DUC及AP-Plasma進行非接觸式清潔的單機系統，可支援UD/LUD，達至非接觸式完全清潔，將頑固的Particle及Organic Pollutant單機清潔完畢

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KURODA GROUP

Thank You For Listening

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