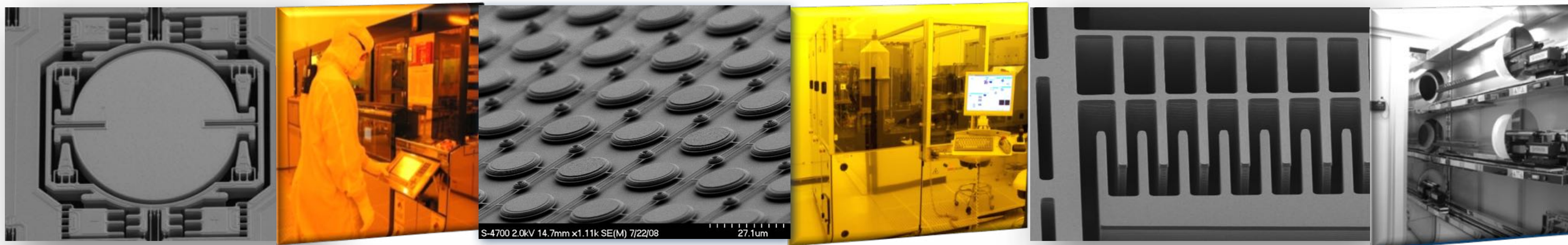
Akoustis MEMS Foundry
July 2017

INNOVATION IN SINGLE CRYSTAL BULK ACOUSTIC WAVE TECHNOLOGY

MEMS OVERVIEW



Akoustis NY Fab; 120,000 sq ft facility, 30,000 sq. ft. **MEMS Foundry** supports 150mm Si, SiC, SOI, Quartz, Glass (300um to 1.2mm) substrates

Vertically integrated source for MEMS design, fabrication, packaging and test services, organized to support prototype, pilot & low-to-mid-volume manufacturing

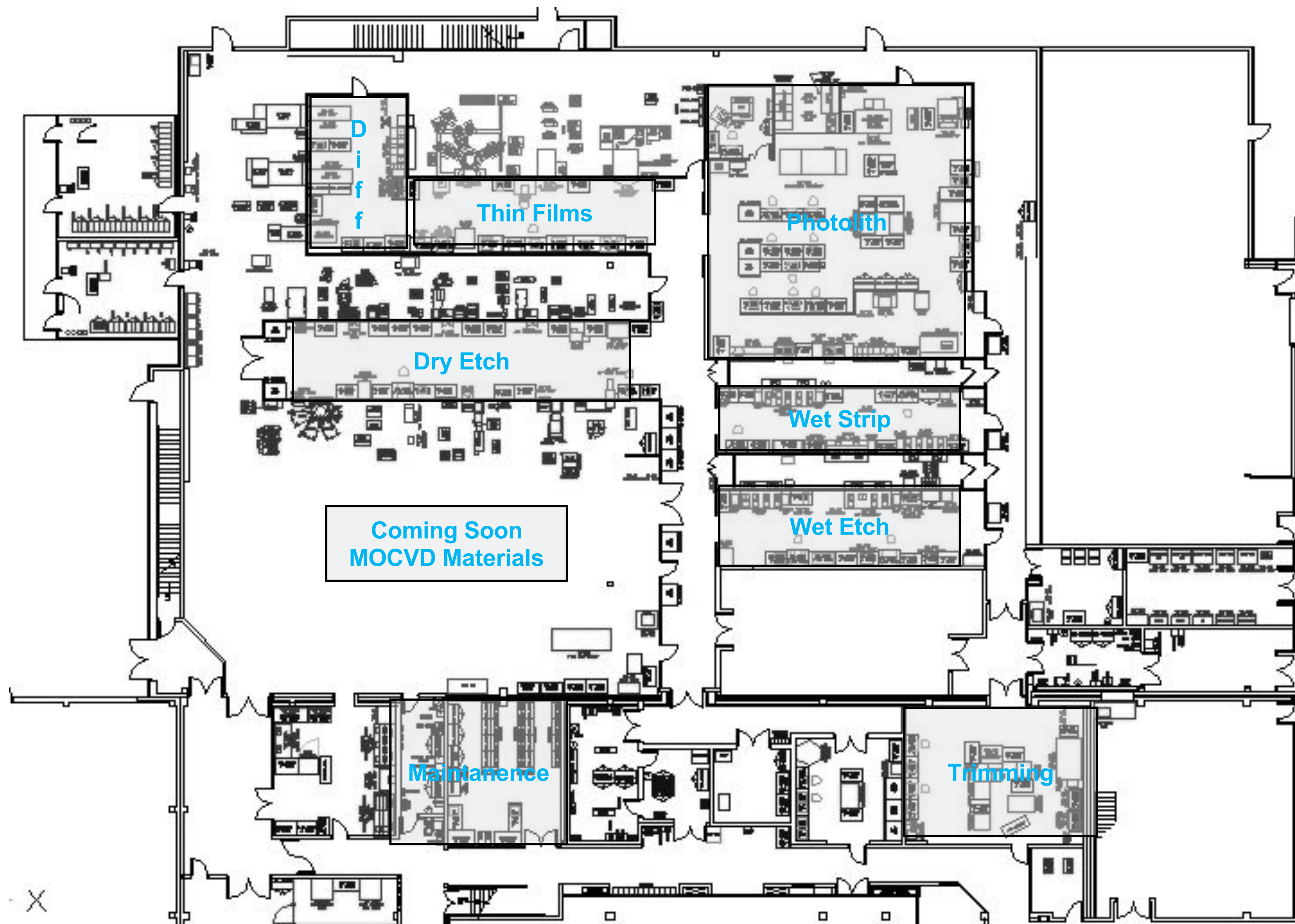
Engineering resources specialized in inertial sensors, biomedical, microfluidics, optical displays, SiOB, thermal imaging, and wafer level packaging

Defense Microelectronics Activity (DMEA) Trusted Foundry Accredited Supplier for:

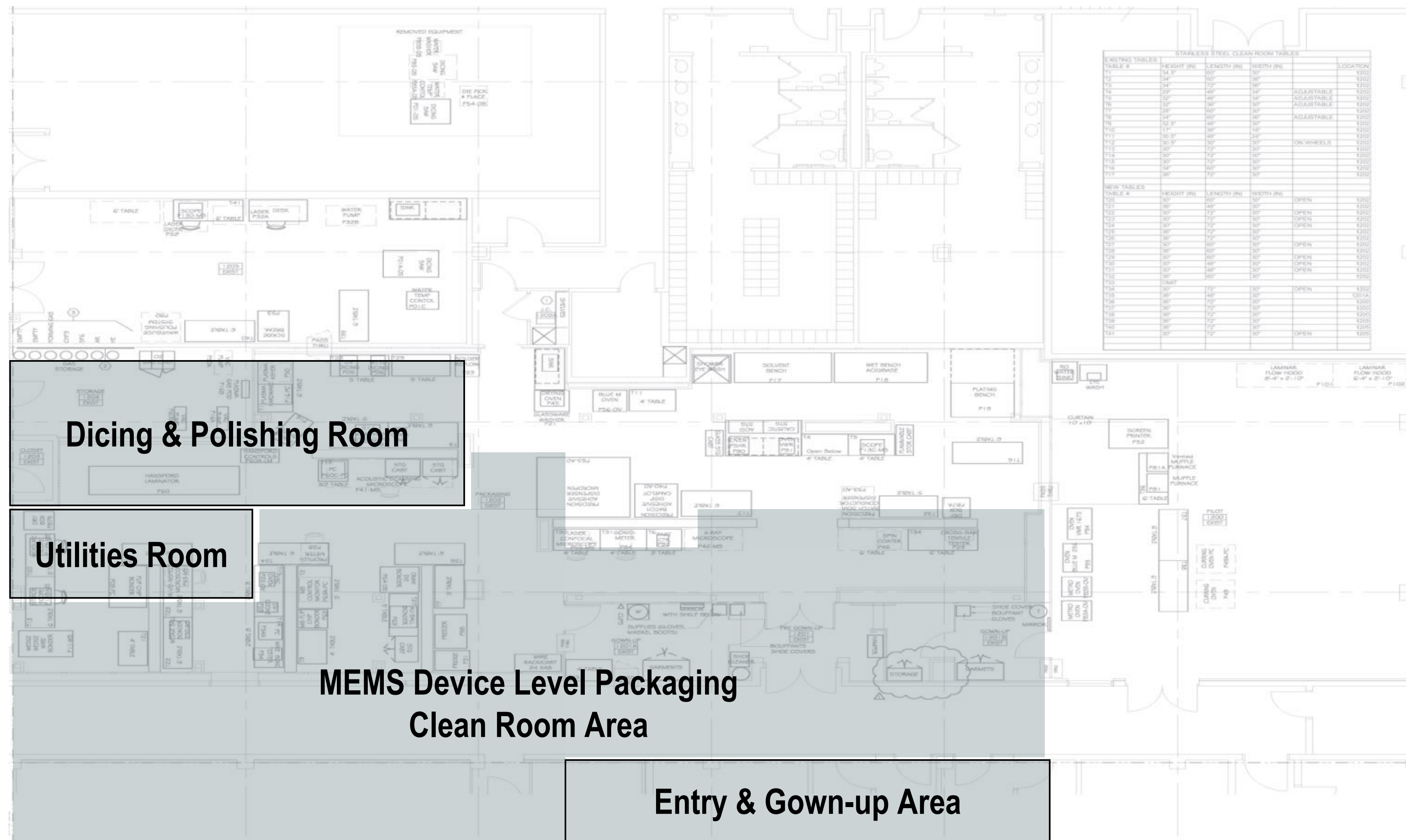
- Post CMOS Processing/MEMS Integration
- Microelectronics Packaging and Assembly
- Aggregation Services

ISO 9001:2008 Quality Management System Certification;

AKOUSTIS NY PLANT - FABRICATION

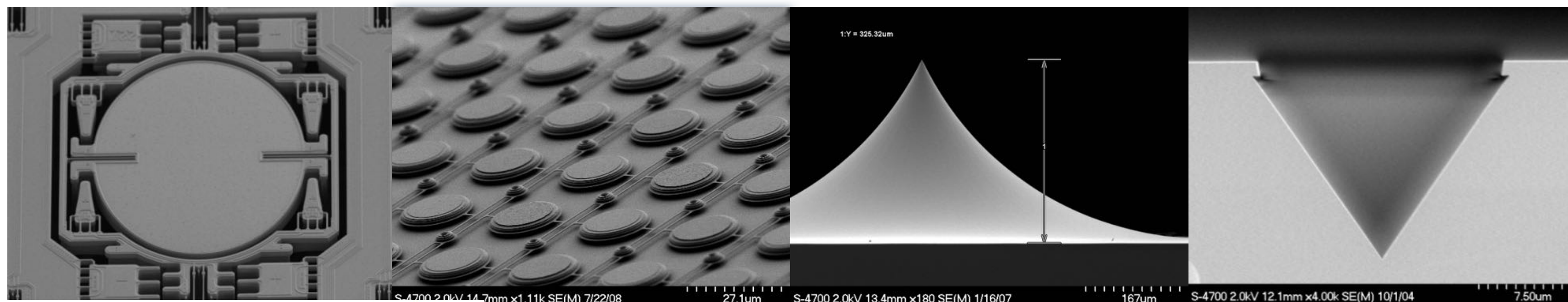


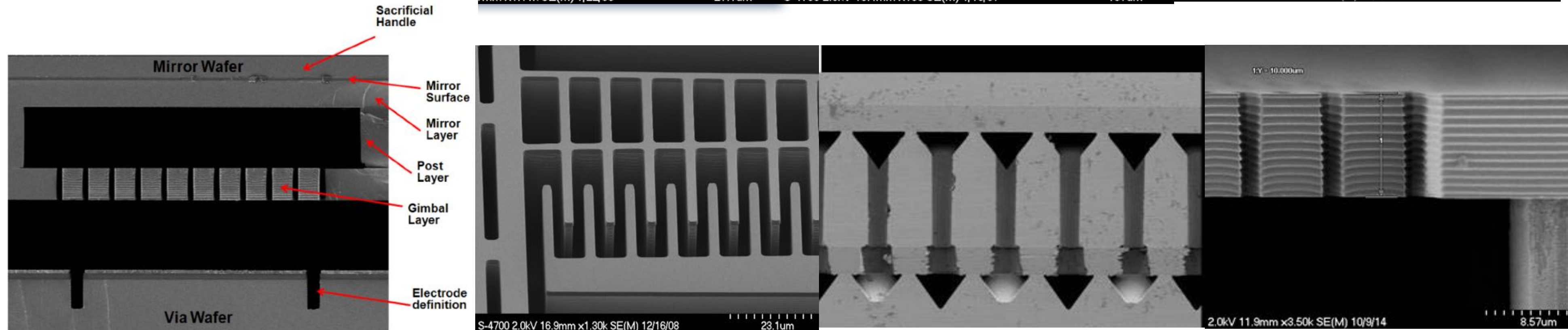
AKOUSTIS NY PLANT – BACK END



AKOUSTIS MEMS CAPABILITIES

Inertial	Optical MEMS	Sensors	Life Sciences
Gyro	SiOB	Chemical	Microneedle Arrays
Accelerometers	Micromirrors	Thermal	DNA Amplification





AKOUSTIS TECHNOLOGIES

PHOTOLITHOGRAPHY

Ultratech XLS 200 4X Reduction Stepper
- 0.5μm Resolution

Ultratech Nano 160 1X Stepper
- Backside Alignment
- 2μm resolution

SUSS MA6/BA6 Contact Aligner
- Backside Alignment

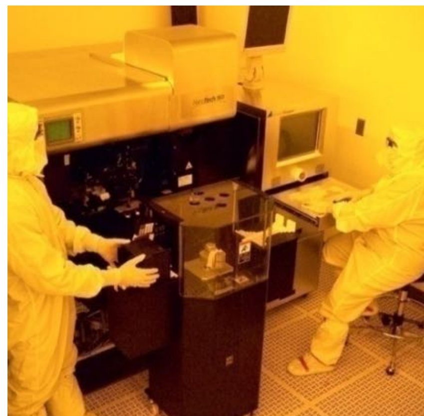
SUSS MA200 Contact Aligner
- Backside Alignment

TEL Track Mark VII & SVG 8800 series Track

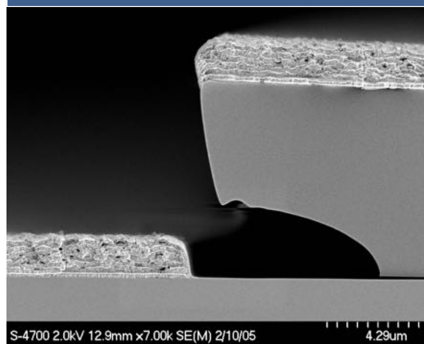
Positive Photoresist
- .65μm to 25μm

Negative Photoresist
- Patterning & Lift-off

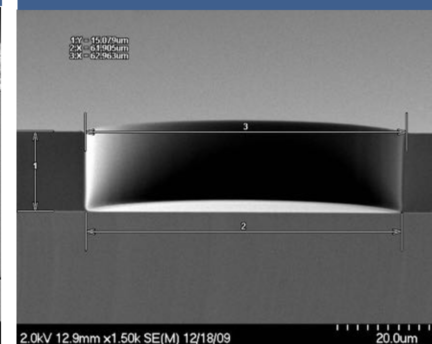
Specialty Films up to 150μm
- SU8, Polyimides, BCB, Barc & CEM films



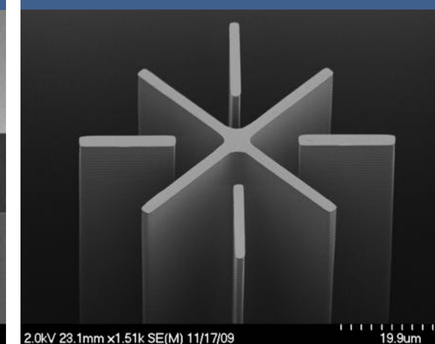
Ultratech Nano160
1X projection stepper
2μm resolution



TEL Mark VII
Coat/ Develop Track



Ultratech XLS 200
4X reduction stepper
0.5μm resolution



MATERIALS

Chemical Vapor Deposition

Bruce Technologies Atmospheric
- Thermal Oxidation
- POCl3 Doping

MOCVD
- Single Crystal III-N growth

LPCVD
- Silicon Nitride
- Polysilicon

AMAT P5000 and Centura
- SiO2, SiN, Oxynitride, a-Si, TEOS
- Low temperature SiO2 and SiN

Physical Vapor Deposition

Sputter Veeco Connexion 8 (DC & RF) & AMAT Endura (DC)
- Ti, TiW, Ta, Mo, ITO, Al, AlSi, AlSiCu, SiO2, Al2O3, AlN

E-beam Evaporation

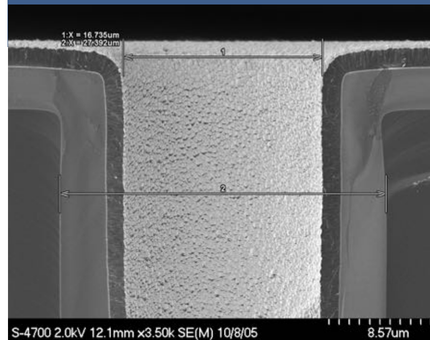
Temescal FCE-2700A
- Cr, Au, Mo, Al, Ni, Sn, Pt, Ti, Ag

Cambridge Nanotech 200ALD
- Al203

CVD

TOX, $POCl_3$, SiN,

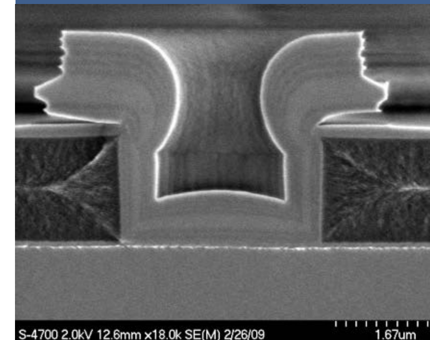
Polysilicon

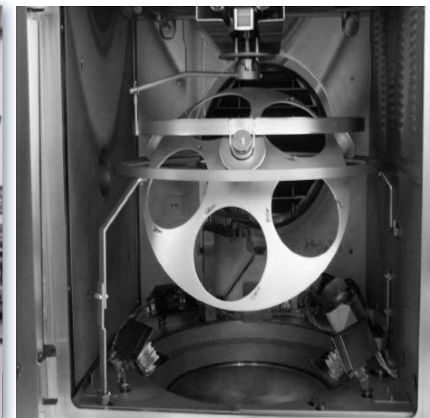


PECVD

SiO_2, SiN, SiON, a-Si, TEOS

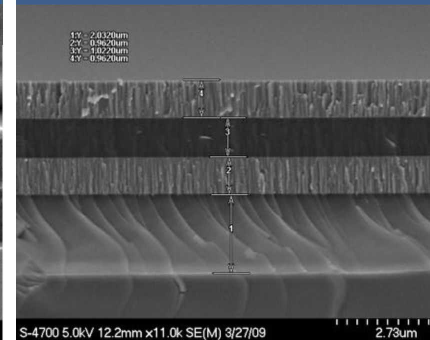
Low temperature SiO_2 and SiN





PVD

Ti, TiW, Ta, Mo, ITO, Al, AlSi, AlSiCu, SiO_2, Al_2O_3, AlN, Cr, Au, Pt, Ni, Ag, Sn



MEMS FABRICATION - ETCH

Plasma Etch

STS ASE DRIE

STS Pegasus DRIE

LAM DSIE

- **DRIE, Buried SiO_2**

LAM 9400PTX

- **Silicon, Polysilicon, Polyimide, SiO_2, TiO_2**

LAM 9600PTX

- **Al, AlSiCu, SISi, Ti, W, Ta, TiO_2, SiO_2, HfO_2, Cr, Mo, AlN**

LAM 4520

- **SiN, SiO_2**

Ion Beam Trimming

AMSystems D1216

- **AlN, SiN, SiO_2, Mo**

Sacrificial Releases

Xactix XeF_2

Ulvac O_2 Polymer Release

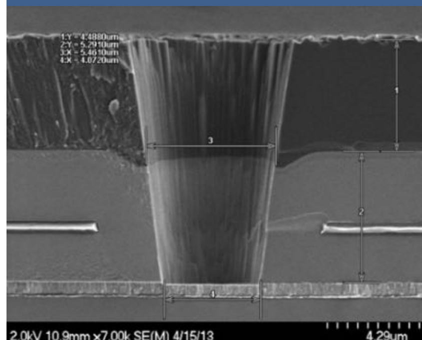
Resist Strip

Ulvac & LAM Microwave O_2 Plasma

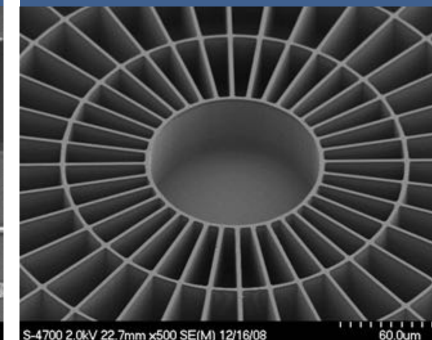
Piranha

EKC 265

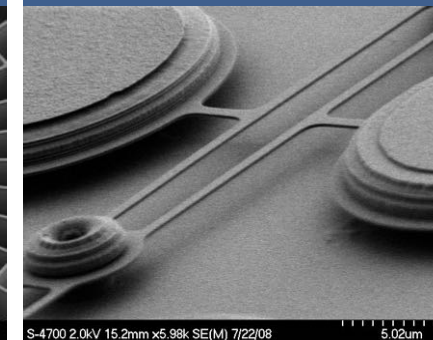
LAM A6 Cluster Tool
9400PTX (Poly)
9600PTX (Metal)
4520XLS (Dielectric)
Microwave Strip



Deep Reactive Ion Etch
STS Pegasus >15um/min
STS ASE <10um/min
LAM DSIE 2um/min



Sacrificial Release
Xactix XeF_2 (Polysilicon, Mo)
Primaxx HF Vapor (SiO_2)
Ulvac Enviro I (Polyimide)



WET PROCESSING / CMP

Wet Processing

JST Wet Benches

- HF, BOE, Hot Phosphoric, KOH, Metal etch (Al, Cr, Ti, TiW, Ni, Au) ITO etch, Piranha, EKC 265, NMP, Lift- off, RCA

CMP/Grind

CMP – Strasbaugh 6EC

- Polysilicon, SiO2, Silicon

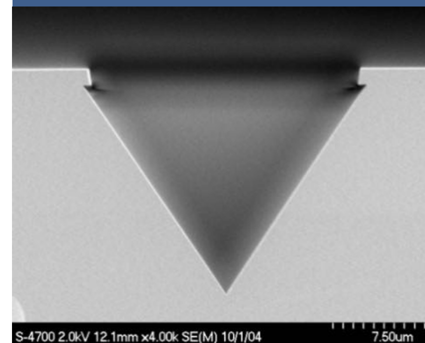
Disco DAG810

- Si & SiC wafer grinding

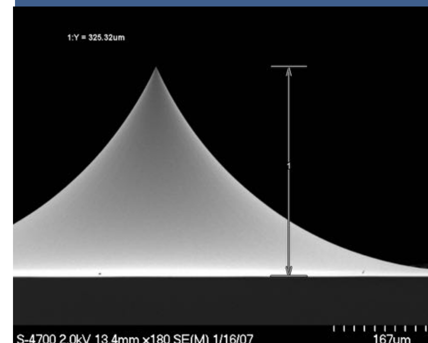
OnTrack DSS200

- CMP wafer scrubber

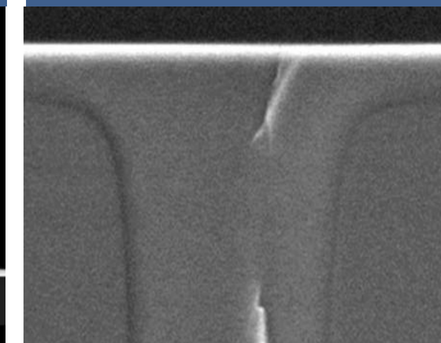
KOH Etch



Piranha,
EKC 265, Lift-Off,
HF Etch



CMP / Grind



WAFER BONDING

Wafer-Scale Bonding

Eutectic, Anodic, Fusion Thermo-compression, Glass Frit, Adhesive

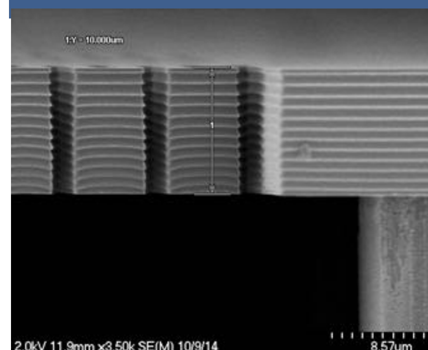
SUSS Automated Bond Cluster – ABC200

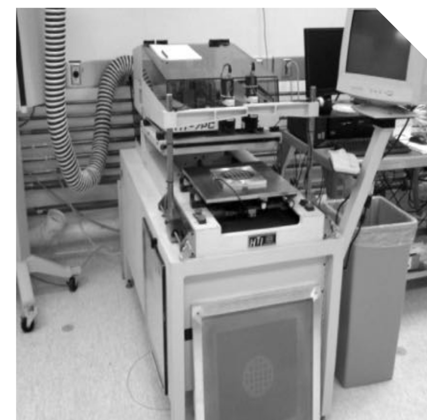
- Wafer to wafer cassette handling
- BA200: Automated alignment via Backside and IR capabilities
- CL 200: In situ cleaning with megasonics and aqueous chemistries
- NP 200: In situ activation of surfaces via atmospheric plasma
- BA200: Bonding via fusion bonding, thermo compression, eutectic solder
- Bond initiation in CL200 or BA200

SUSS Manual Bond - SB6

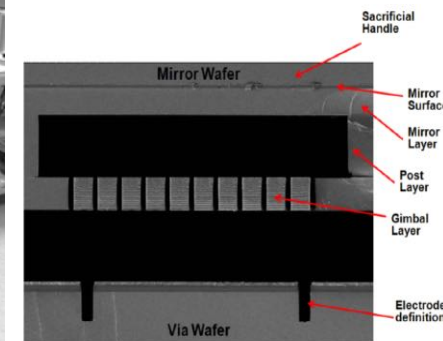
HTI-7 Screen printer

Suss ABC200
AuSn Eutectic, Au-Au, Fusion

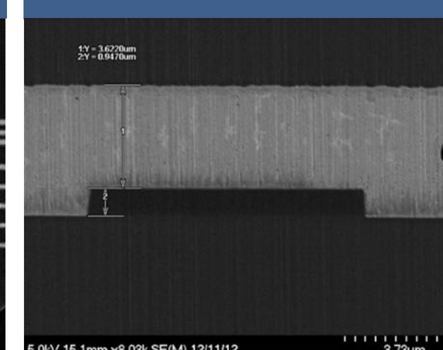




HTI-7 Screen Printer
Glass Frit



Suss SB6
Glass Frit, Adhesive, Anodic Bonding



MEMS PACKAGING

Dicing

ADT 7200 Dicing Saw

- Dice substrates up to 12inch
- Glass, silicon, plastic
- Taping unit
- Integrated wafer cleaning
- Atomized wafer cleaning

Device Level Assembly

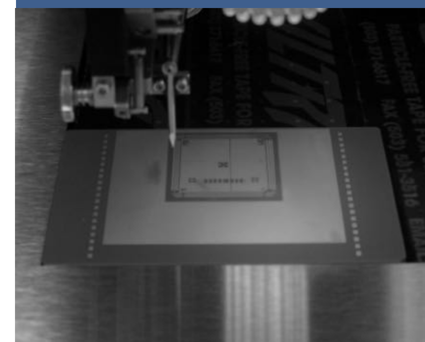
- Adhesive dispensing
- Precise volume and position
- Asymtek Spectrum S820
- Automated fluid dispensing

Plasma Processing/Cleaning

Oxford Plasmalab 80 Plus-RIE System, UV/ozone cleaning, JST Solvent, Acid & Base Benches

ADT 7200 Dicing Saw

Asymtek Spectrum



Electroplating

MEMS PACKAGING CONT.

Flip Chip/Die Bonding

SET FC150

- 1µm accuracy placement
- 100kg max. force
- Chip size: 200µm up to 4”
- Substrate size: 250µm up to 6”

Wirebonding

Fine pitch and deep access bonding with Au and Al wire

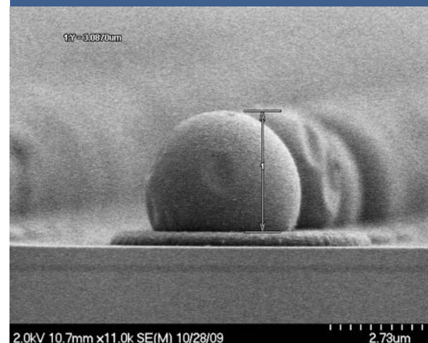
H7K BJ815 automatic wedge bonder
K&S 4700 ball wirebonder

Hermetic Package Sealing

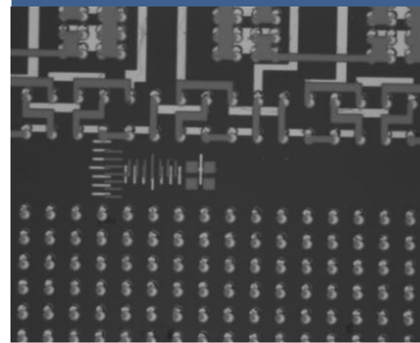
SSEC dry box

- Resistive weld seam sealer
- Resistive weld solder

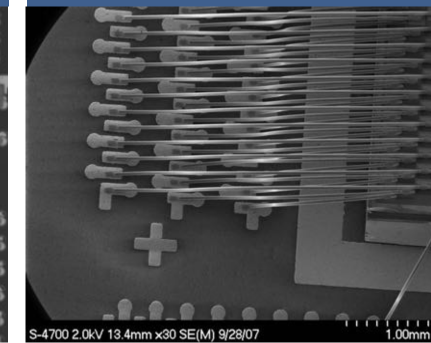
FC150
1µm placement



SEC 860 : 10µm



Automated
Wedge Bonder



AKOUSTIS TECHNOLOGIES

METROLOGY & TESTING

Electrical Testing
Suss Microtec PA200 probe tester

CD Scope
Nikon Eclipse 200

Electrical Characterization
MDC CV Tester
Suss Probe Station

Wirebonding
Dage Precision Industries 4000 wire pull & shear tester

Process Monitoring/ Failure Analysis
Hitachi FESEM with EDAX Zygo Optical Profilometer, Woolam Ellipsometer, Filmetrics F50, N&K 1500, Tencor Surfscan 6400, Tencor P10, Tencor P15, ASIQ, Nanospec 210, Flexus 2620, MTI Autoscan 200, CDE Resmap 16, Bruker D8 HR-XRD, Rudolph Technologies MetaPULSE

Dage Pull/Shear Tester

Suss Microtec PA200

Hitachi FEM SEM
Woolam Ellipsometer

Zygo Profilometer

Tencor Surfscan 6400