

# 200 mm MEMS cleanroom toolpark

| LITHOGRAPHY   |  |                                    |
|---|--|------------------------------------|
| Exposure  | DUV for 130 nm l/s   | NSR-S210D   Nikon                  |
|   | i-Line for 400 nm l/s  | NSR-2205i 14E2   Nikon             |
| Coating   | Spin and Spray   | SK-80EX   Screen                   |
| Contact, Proximity                                    | Double-side Mask Aligner   | MA 200 GEN 3   SUSS                |
|   | Overlaytool with 3s < 15 nm  | MueTec – MT3000IR                  |
| DEPOSITION  |  |                                    |
| PE-CVD  | Silicon Oxide as ILD and Sacrificial Layers                              | Centura   Applied Materials        |
|   | a-Si:H as Sacrificial Layers   |                                    |
|   | Silicon Nitride for Passivation / Membrane                               |                                    |
|   | HDP Oxide as ILD and Sacrificial Layers                                  |                                    |
| PVD-Sputtering  | SiGe as Construction Layer   | Sigma 204   SPTS                   |
|   | Interconnects (Al, AlSiCu, Ti, TiN)                                      |                                    |
|   | Chemical Sensors and Barriers (Ta, Ta <sub>2</sub> O <sub>5</sub> , HfO) |                                    |
| Evaporation   | Mirrors and Hinges (Al, TiAl, Al-Alloys)                                 | CS400S   Von Ardenne               |
|   | Al, SiO <sub>2</sub> , Al <sub>2</sub> O <sub>3</sub>                    | PLS 570   Balzers                  |
| Oxidation   | Al, SiO <sub>2</sub> , TiO <sub>2</sub>                                  | Evatec BAK 761                     |
|   | Thermal, SiO <sub>2</sub> (horizontal)                                   | Inotherm                           |
| Rapid Thermal Annealing                               | Thermal, SiO <sub>2</sub> (vertical)                                     | Alpha 8SE   TEL                    |
| Chemical Mechanical Polishing                         | Annealing  | Heatpuls 8800   OEMgroup           |
| Grinding  | Si, SiO <sub>2</sub>   | DESICA   Applied Materials         |
| LP-CVD  | SOI-preparation  | Grindertool   DISCO Corp.          |
|   | Poly-silicon for Trench Fill / Sacrificial Layer                         | E1550 HT 320-4   Centroterm        |
|   | Silicon Oxide for Insulator, Membranes                                   |                                    |
| Silicon Nitride, Low Stress Silicon Nitride (200 MPa) |  |                                    |
| Atomic Layer Deposition                               | SiO <sub>2</sub> , Al <sub>2</sub> O <sub>3</sub> , HfO <sub>2</sub>     | P-300   Picosun                    |
|   | FDTS for Anti-Stiction   | MVD 300 Batch Reactor   SPTS       |
| Gas Phase Release Techniques                          | HF-GPE for SiO <sub>2</sub>  | MEMS-CET system   Primaxx          |
|   | XeF <sub>2</sub> for a-Si  | X-SYS-3B:6   Xactix and CVE   SPTS |

| ETCHING AND CLEANING                                       |  |   |
|--|--|---|
| Dry Etch   | Metal etch (Al / Al alloys)  | ALLIANCE 9600PTX   LAM  |
|  | Dielectrics & Poly Etch (SiO <sub>2</sub> , Si <sub>3</sub> N <sub>4</sub> , PolySi, a-Si)   | Omega fxP   SPTS  |
|  | Deep silicon etch  | Rapier Modules  |
| Wet Etch   | Silicon Oxide (NH <sub>4</sub> F-buffered HF)  | Manual wet bench   AP&S   |
|  | Silicon Nitride (Phosphoric Acid)  |   |
|  | Aluminum (Phosphoric & Acetic Acid)  |   |
|  | Anisotropic Si Etch for Grooves, Membranes (TMAH)  |   |
| Cleaning   | Wafer Cleaning (SC1, SC2, DHF, RCA)  | GigaStep   AP&S   |
|  | GigaStep   AP&S  | SS-80BW-AVR   Screen  |
|  | Wet Strip (EKC clean)  | Cintillio SST   OEMgroup  |
| BONDING & ASSEMBLY   |  |   |
| Wafer Bonding  | Direct Si / SiO <sub>2</sub> and Adhesive Bonding  | BA8 Gen3, SB8, XB8   SUSS   |
| Wafer Dicing   | Dicing of Glass-Silicon-Compound   | DAD 651   Disco   |
| Wafer Packaging  | Pick & Place for Chip Assembly   | VICO Xtec / Laser   Häcker Automation   |
|  | Fineplacer   | FEMTO   Finetech  |
| METROLOGY & INSPECTION                                     |  |   |
| Film Thickness Measurement                                 | Optical Thickness Measurement of Standard Materials  | Lambda Ace RE-3300   Screen   |
|  | In line Reflectance measurement  | n & k Olympian  |
| Scanning Electron Microscope                               | 3D Inspection  | JSM-6700F   JEOL  |
|  | Analysis SEM with FIB cut  | Helios Nanolab 660   FEI  |
| CD-SEM   | CD Measurement   | Verity Lite   Applied Materials   |
| Atomic Force Microscope                                    | Surface Topology   | Nanoscope D3100   Veeco   |
| Ellipsometer   | n&k Measurement, Optical Properties  | V-VASE (190 ... 1700 nm)   Woollam  |
| White Light Interferometer                                 | Surface Topology   | NT8000   Veeco  |
| Laser Scanning Microscope                                  | Surface Topology   | VK-X200   Keyence   |
| Defect Measurement   | Defect Inspection  | Compass Pro   Applied Materials   |
|  | Defect Classification  | INS3000   Leica   |
|  | Defect Classification  | FAaST 230   Semilab   |
| Actuation Measurement                                      | Ultra High Frequency Vibrometer  | UHF120   Polytec  |
| ELECTRICAL TEST  |  |   |
| Mixed Signal Testing                                       | 176 digital pins (200 MHz), 24 analog pins, 8 HV bus pins, 6 x 52 V / 0.2 A supply, 2 x 80 V / 20 A supply, various digitizers & generators, wafer size 4", 5", 6", 8", 12"; temperature: -40 ... +125°C | M3670-Falcon / EG4090μ+<br>Advantest<br>PA300   |
|  | 72 digital pins (200 MHz), 32 analog pins, 6 x 52 V / 0.2 A supply, 51 V / 5 A supply, various digitizers & generators, wafer size 4", 5", 6", 8", 12"; temperature: -40 ... +125°C                      | M3650 / EG4090μ / UF3000EX<br>Advantest   |
| Parametric Test System                                     | 48 channels, wafer size 4", 5", 6", 8", 12"; temperature: -40 ... +125°C   | B1500 / EG4090μ / UF3000EX Keysight   |
|  | Matrix up to 72 channels, wafer size 6 ... 8", temperature: -40 ... +125°C   | S530 basic   Keithley / EG4090μ+<br>temperature: -40 ... +125°C   |
| Electro-optical Test System for Micro Displays and Sensors | Color & luminance measurements, DUT images up to 16 Mpix wafer size up to 12"; capabilities for bare dies or modules, temperature: -40 ... +125°C  | Color Measurement System LMK98-4,<br>F1600C Pike Camera, Spectrometer<br>Jeti Specbos 1211UV   PA300 Cascade<br>Micro- tech |
| Sensor Actor Test System for MEMS / MOEMS                  | Wafer size 8", temperature: 15 ... 125°C, SMU, laser light barriers, frequency counter, switch matrix, up to 72 channels   | AP200   Cascade Microtech, changeable<br>chuck-addons for MEMS probing  |
| Optical Inspection   | Manual or fully automated image processing   | PA200   Cascade Microtech   |
| Non-electrical Test  | Up to 20 channels, configurable set points -45°C ... 145°C @ (1.4 deg / min) rH controlled 300 N sine; up to 5000 g pulse  | pH Sensor Tester Fraunhofer IPMS Thermal<br>Callibration Feutron ESPEC Shock<br>and Vibration LDS, Endeveco                 |
| CV Analysis  | Oxide thickness; flat band voltage; effective oxide charge; average bulk dop.; threshold voltage; Debye length; interface trap density   | LF and HF CV  |
|  | Relaxation time; minority carrier lifetime; surface scan velocity  | TVS; CV BTS   |
| Characterization of Insulator Integrity and Reliability    | Breakdown field; Weibull plot; Time / charge to breakdown  | Eramp and Econst (TDDB)   |
|  | Time / charge to breakdown; breakdown voltage; Weibull plot  | Jramp; Jconst   |