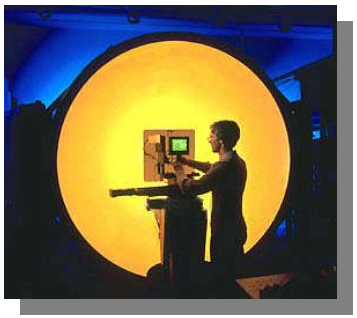
Nano SRMs/RMs

- RMs 8011-8013 Gold nanoparticles
- 8281/2481 CNT (suspension)

- Polystyrene spheres
- Dimensional features on substrates
- Future developments

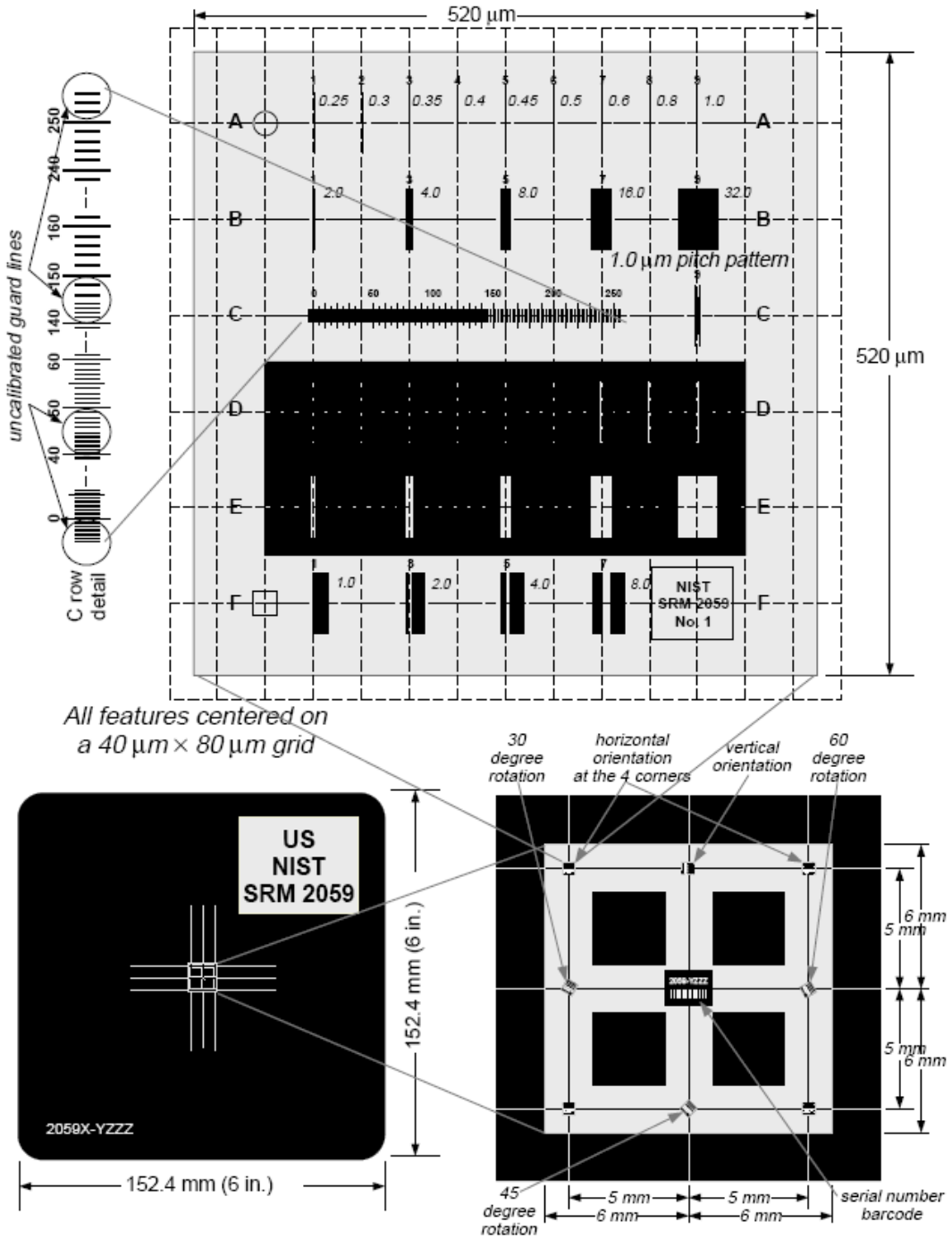


Polystyrene Spheres

- SRM 1963a – Nominal 100 nm diameter
  - 5 mL of polystyrene spheres in deionized filtered (0.2 µm pore size) water
  - Modal Diameter 101.8 nm ± 1.1 nm
- SRM 1964 – Nominal 60 nm diameter
  - 5 mL of polystyrene spheres in deionized filtered (0.2 µm pore size) water
  - Modal Diameter 60.39 nm ± 0.63 nm

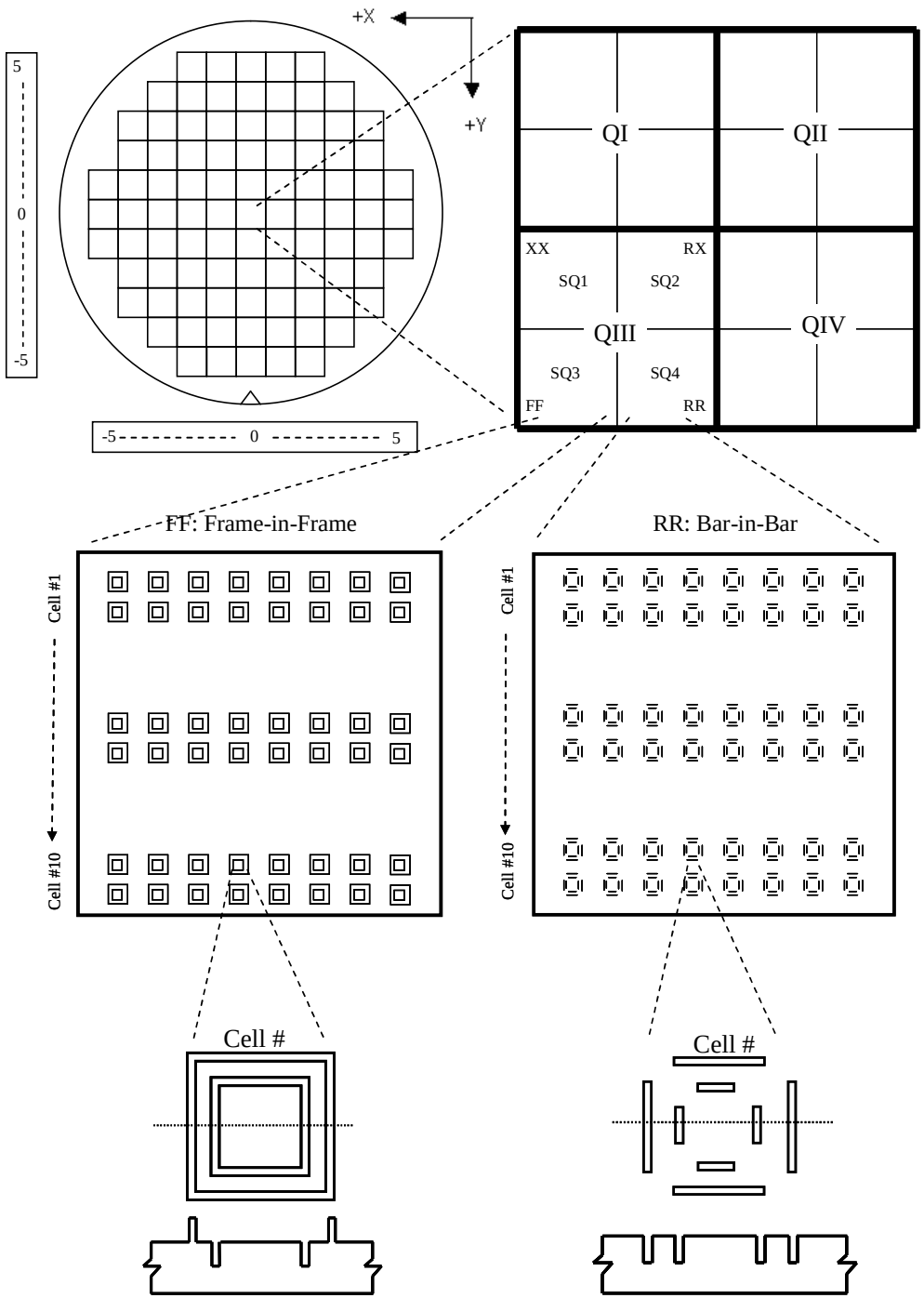
SRM 2059
Photomask Linewidth Calibration Standard

- Nominal 152.4 mm × 152.4 mm × 6.35 mm quartz substrate
- Patterns of clear and opaque lines
  - 0.25 µm to 32.0 µm width
  - 0.5 µm to 250 µm spacing
  - Position uncertainties approximately 13 nm to 25 nm


520 µm
520 µm
0.25
0.3
0.35
0.4
0.45
0.5
0.6
0.8
1.0
2.0
4.0
8.0
16.0
32.0
1.0 µm pitch pattern
uncalibrated guard lines
C row detail
NIST SRM 2059 No. 1
All features centered on a 40 µm × 80 µm grid
US NIST SRM 2059
2059X-YZZZ
152.4 mm (6 in.)
152.4 mm (6 in.)
30 degree rotation
horizontal orientation at the 4 corners
vertical orientation
60 degree rotation
6 mm
5 mm
5 mm
6 mm
45 degree rotation
5 mm
6 mm
5 mm
6 mm
serial number barcode

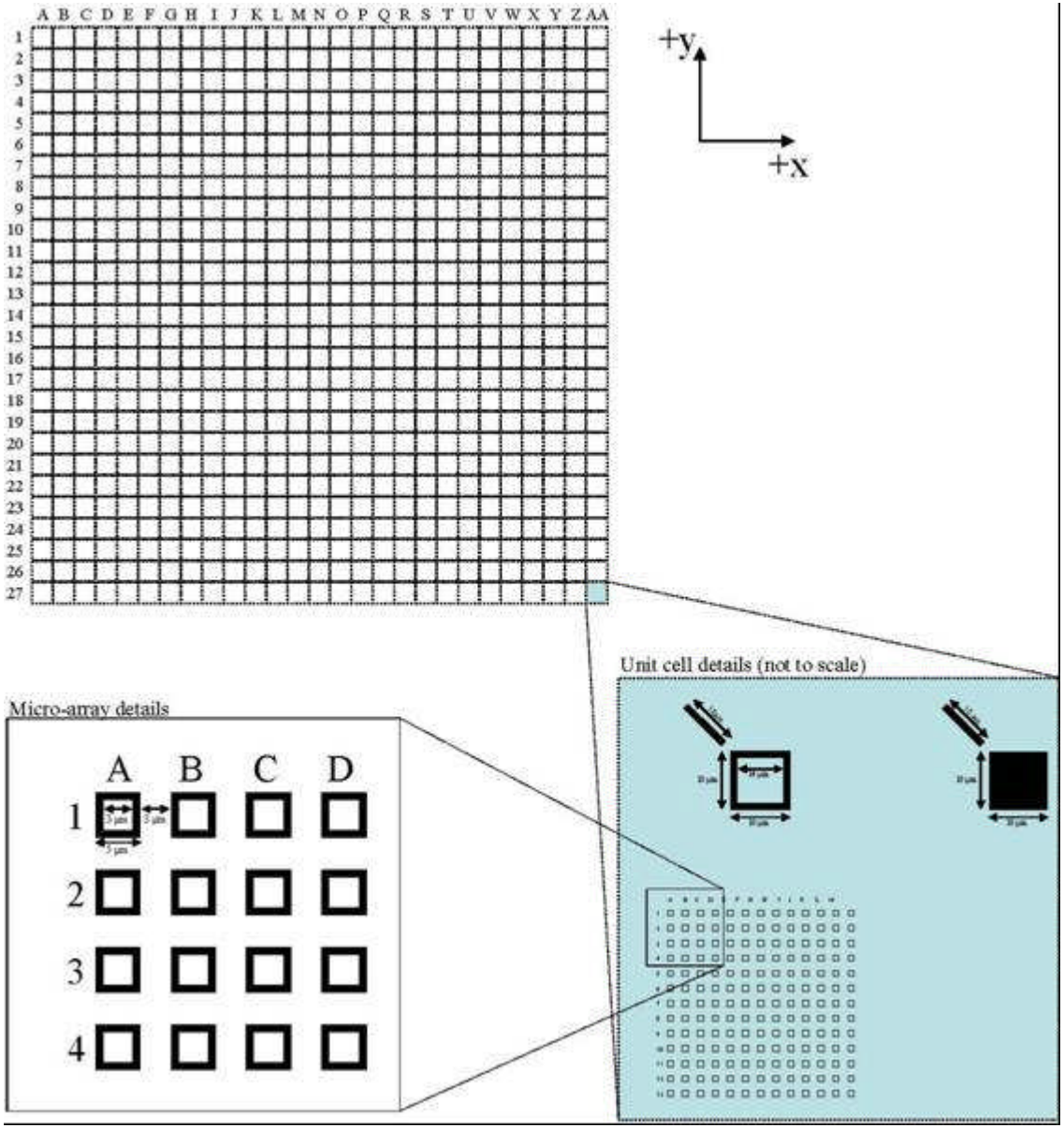
SRM 5000 Overlay Wafer Standard

- 200 mm double-etched silicon wafer containing calibrated overlay targets
- Grid of 93 rectangular dies, each die measuring 17.6 mm in the X-direction and 16.0 mm in the Y-direction
- Position from fractional to 120 nm with uncertainties approximately 2 nm to 3 nm


+X
+Y
5
0
-5
-5
0
5
QI
QII
XX
RX
SQ1
SQ2
QIII
QIV
SQ3
SQ4
FF
RR
FF: Frame-in-Frame
RR: Bar-in-Bar
Cell #1
Cell #10
Cell #1
Cell #10
Cell #
Cell #

SRM 5001
Two-Dimensional Grid Photomask Standard

- Grid of 27 × 27 unit cells printed on fused quartz substrate 15.2 cm × 15.2 cm × 0.64 cm
  - Nominal 5 mm pitch between cells
  - Each unit cell contains a single frame, a solid box, and a 13 × 13 micro-array of frames.
  - Frame: 2 µm lines, 18 µm edge to edge (square);
  - Micro-array: 1 µm lines, 5 µm edge to edge (square), 8 µm pitch (center to center)
  - Distance uncertainties $7.0 \times 10^{-8} \times L + 17.4$ nm


A B C D E F G H I J K L M N O P Q R S T U V W X Y Z AA
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
+y
+x
Unit cell details (not to scale)
Micro-array details
A B C D
1 2 3 4

Under Development

- 8090a & 8120 SEM magnification
- 8111 Si linewidth
- 8475 CNT (dry)
- Reference Cantilevers for AFM
- (25 years of nanometrology in chemical analysis)