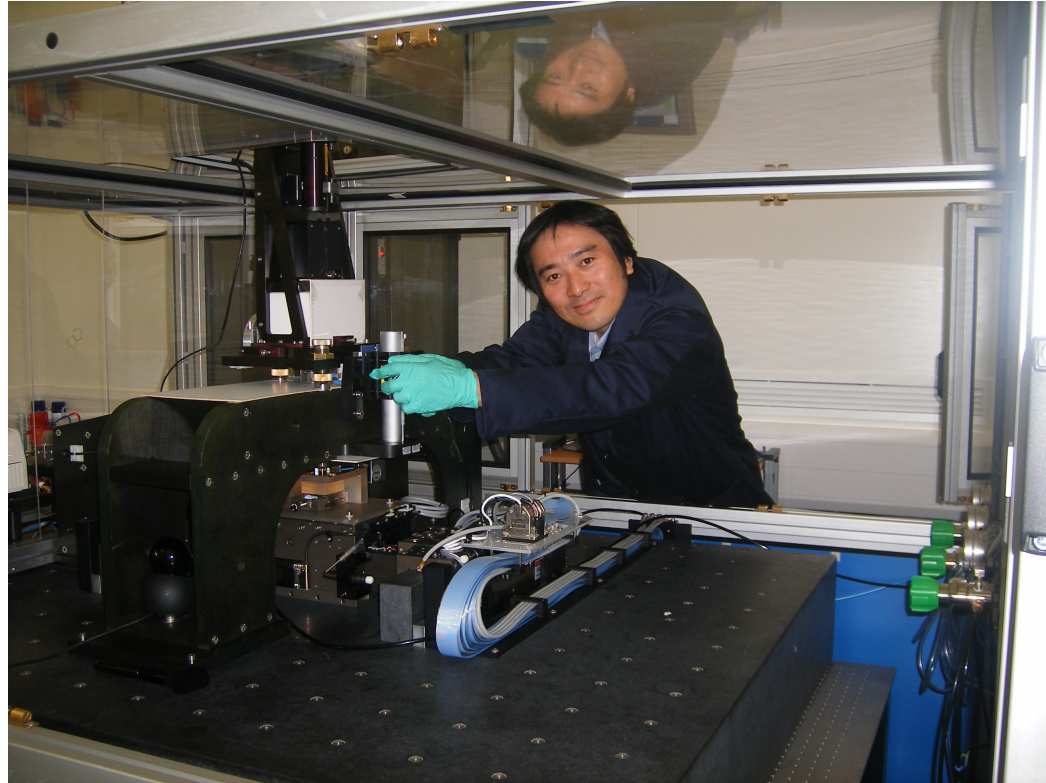


A traceable areal surface texture measuring instrument – *xy* metrology

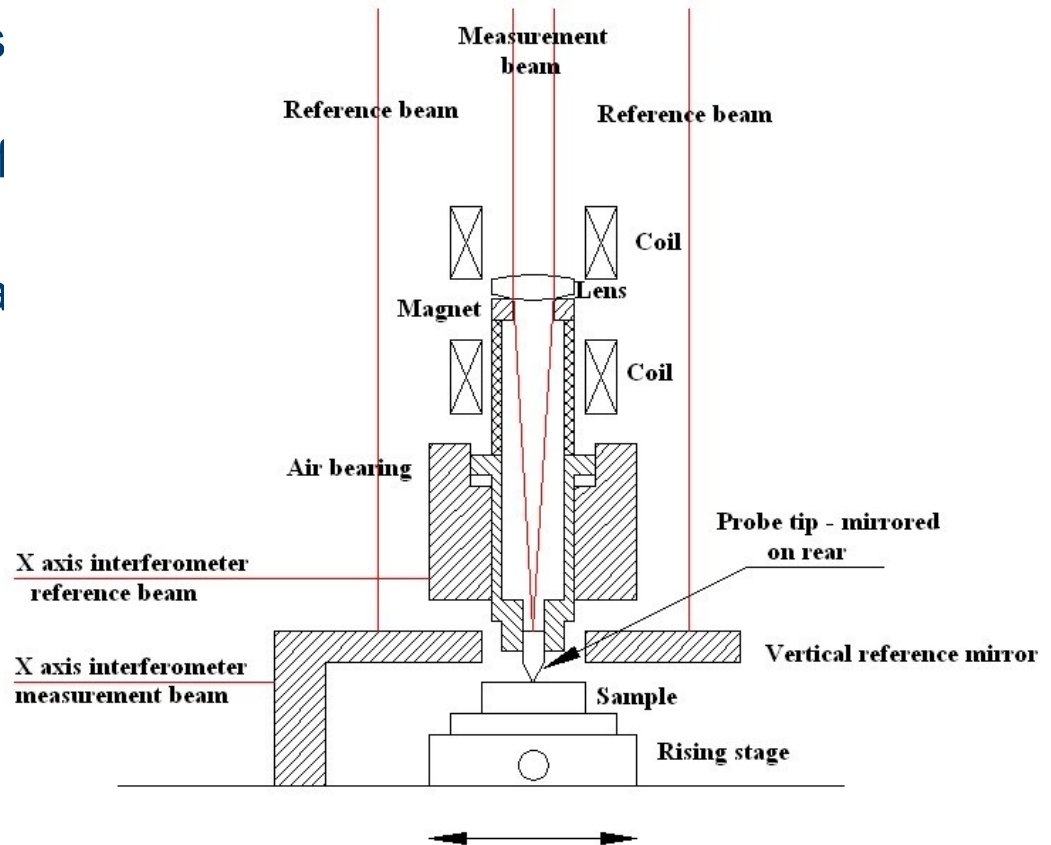
- Working volume 8 mm x 8 mm x 0.1 mm to an uncertainty of 10 nm x 10 nm x 1 nm
- Stylus instrument (see previous!)
- Uses co-planar *xy* air bearing, 4 dof of interferometry
Mathematical model applied to process the uncertainties



Leach R K *et al* 2008 Development of a new traceable areal surface texture measuring instrument *Wear* **266** 552-554

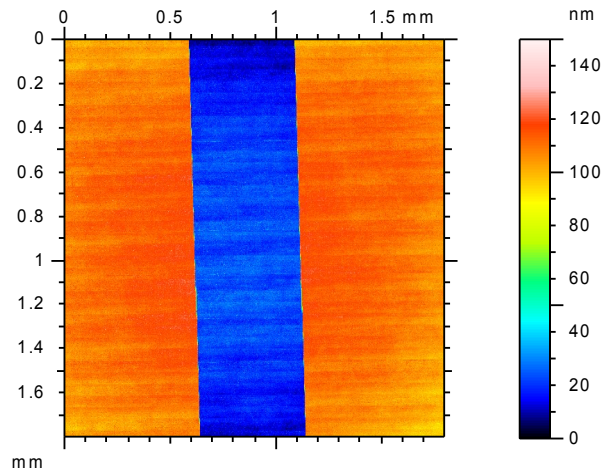
A traceable areal surface texture measuring instrument – z metrology

- Probing system in z is a stylus design that probes through one of the mirrors
- Motion controlled by a air bearing (FFD) and an electro-magnetic force controller
- Uses differential interferometry to “remove” the effect of the metrology frame



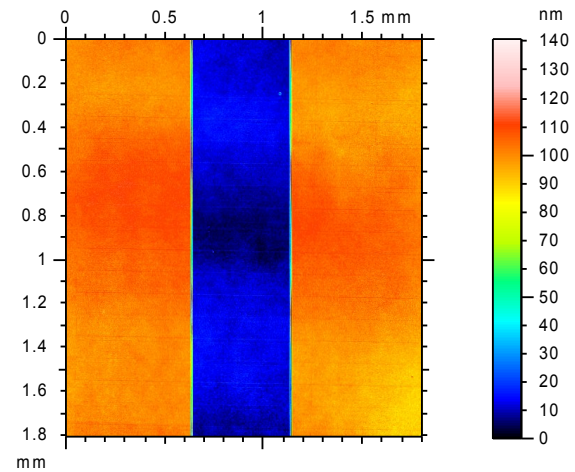
100 nm step – 0.5 mm wide

- Areal Instrument



$$h = 90.42 \text{ nm}$$

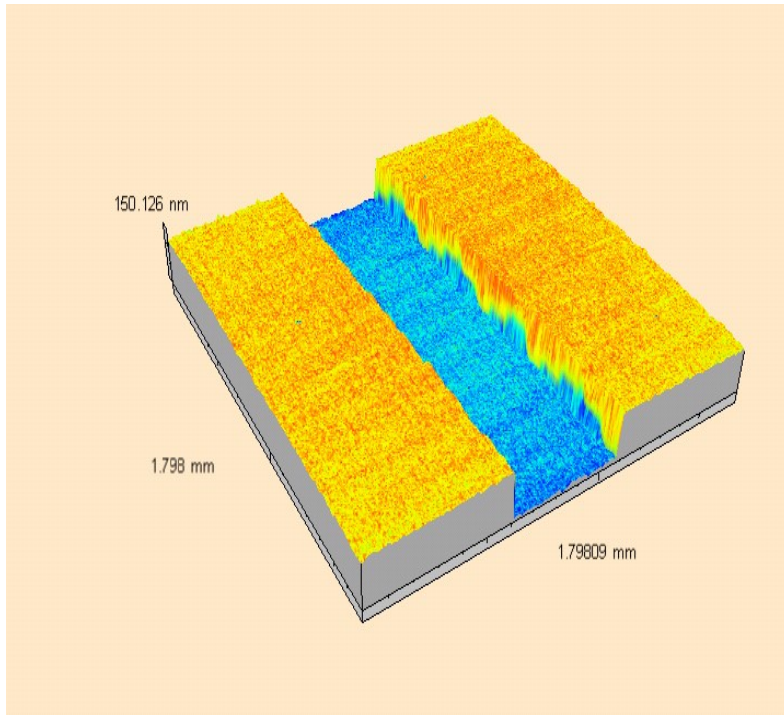
- WLI



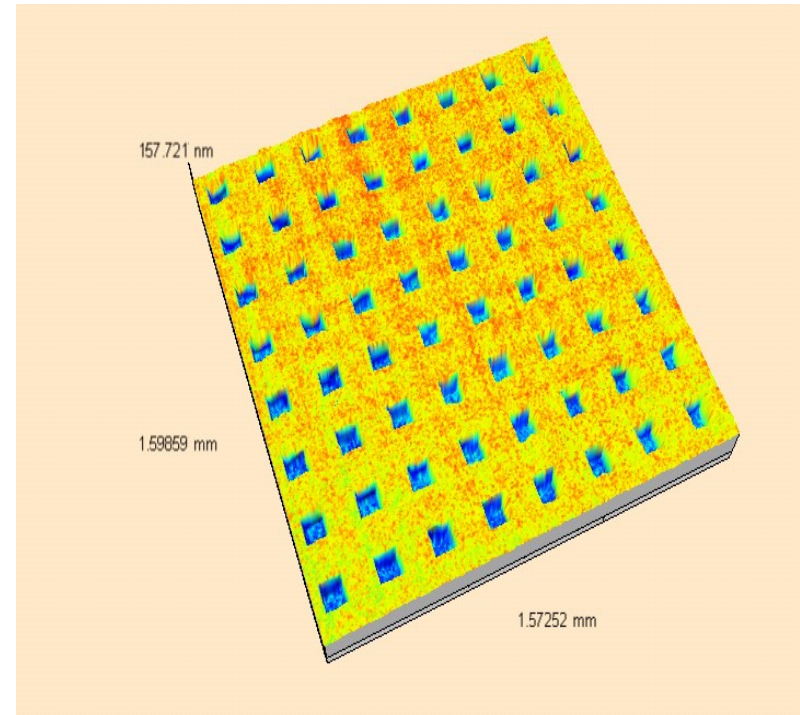
$$h = 91.00 \text{ nm}$$

3D image - Areal Instrument

- 100 nm step

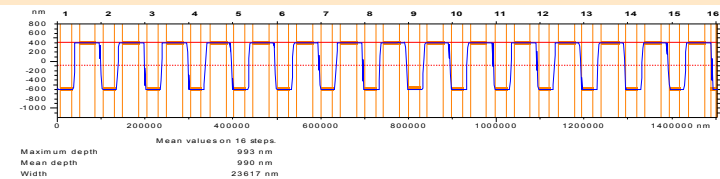
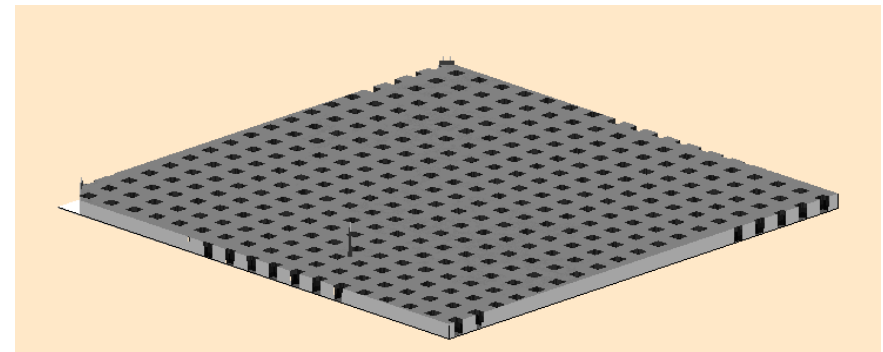
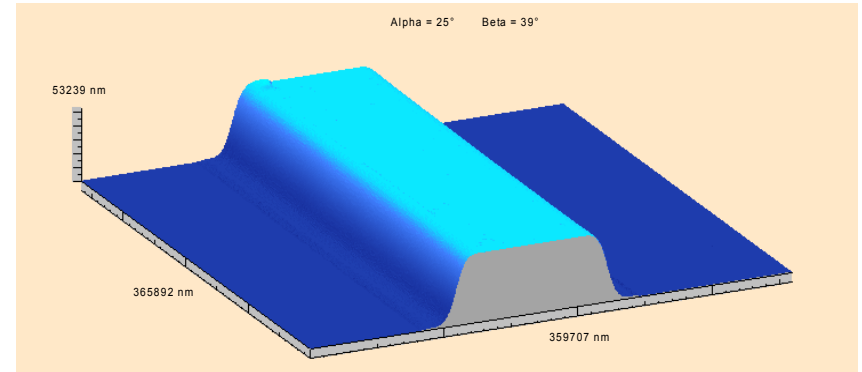


- Waffle plate



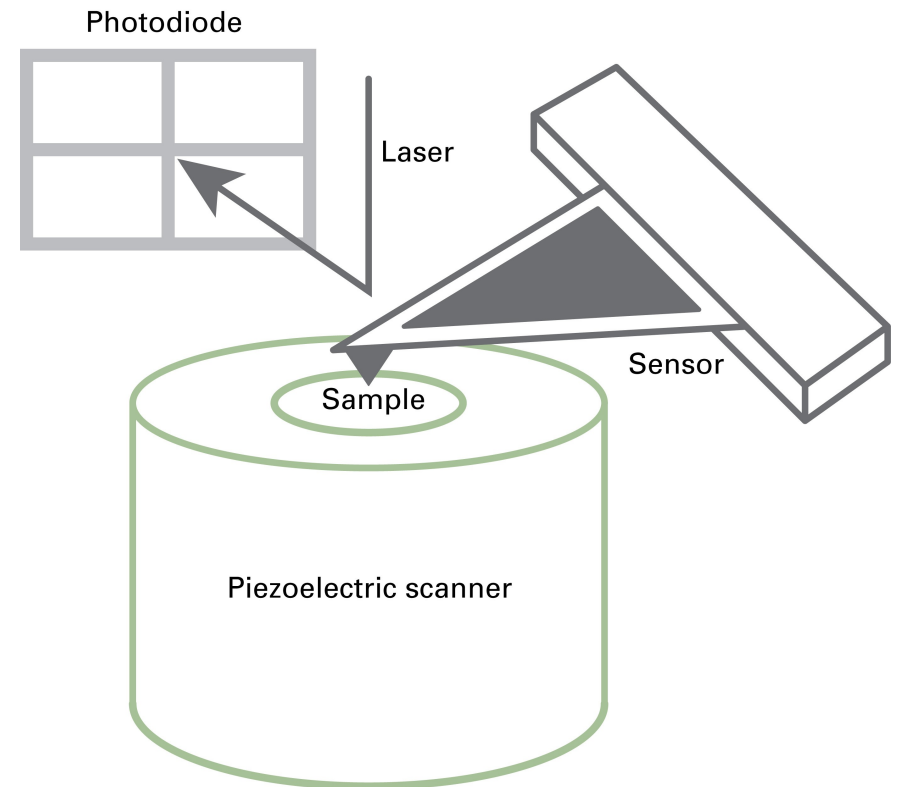
Areal transfer artefacts

- Developing artefacts to be compatible with stylus and optical instruments (ISO 25178 series)
- Artefacts manufactured using a range of processes as part of EU project



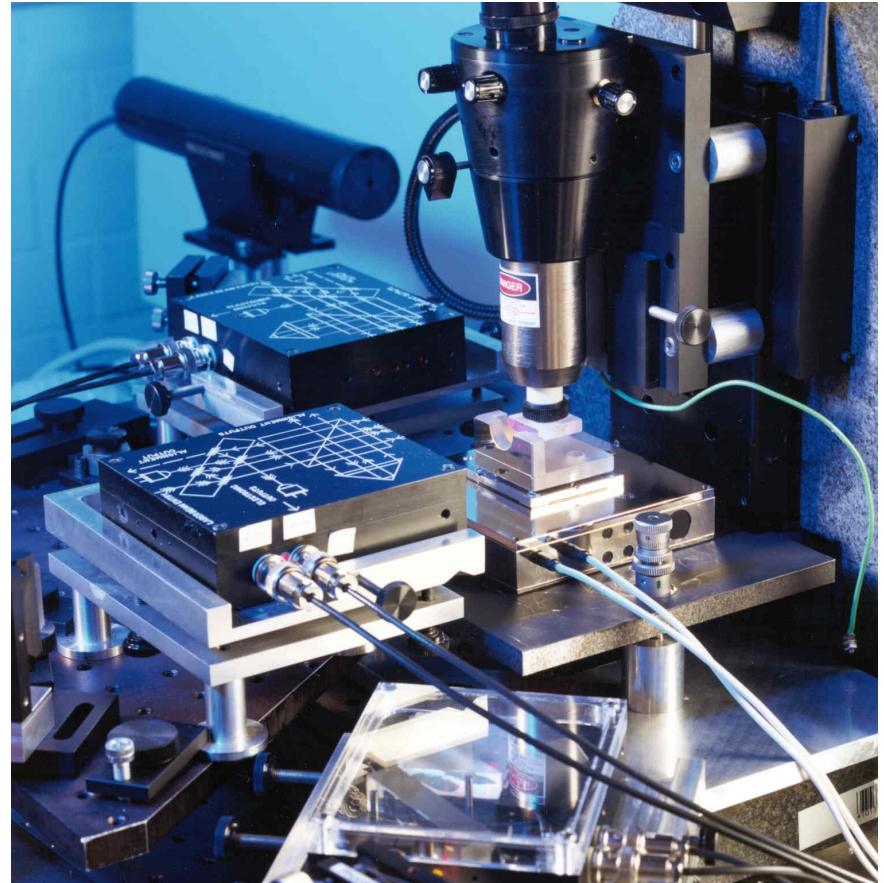
Atomic force microscopy

- Widely used – but not much in industry
- Each has its own nanometre!
- Difficult to use and slow
- Need calibration but also good practice guidance



Metrological AFM

Provides certified calibration of SPM dimensional height and pitch standards, traceable to the national standard for length



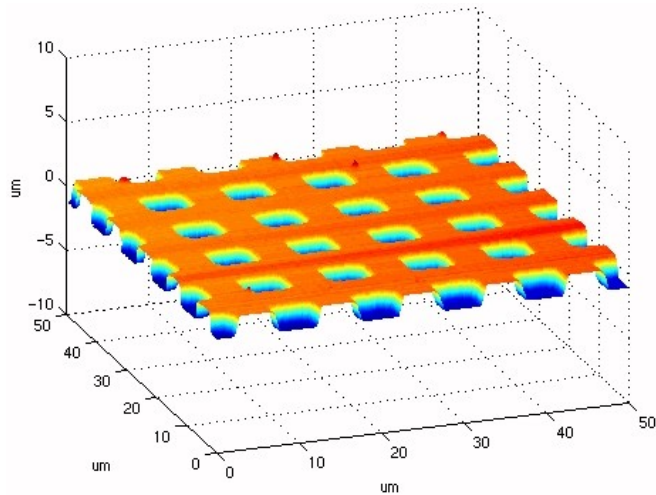
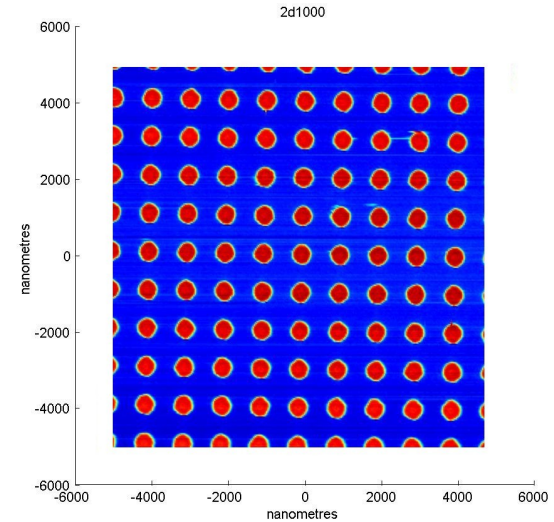
Haycocks J A, Jackson K 2005 Traceable calibration of transfer standards for scanning probe microscopy *Precision Engineering* **29** 168-175

Metrological AFM

Transfer standards

Line gratings or 2D arrays for calibration of X and Y scales, with pitches in the range 300 nm to 10 μm

Typical uncertainties 300 nm \pm 0.2 nm
10 μm \pm 2 nm



Step height standards for calibration of z axis scale:

Nominal step heights 10 nm to 2.5 μm
Typical uncertainties 10 nm \pm 0.4 nm
2.5 μm \pm 15 nm