

Precision Measurements Group (PMG)

Beyond Measure

PMG focuses on optical and non-optical measurement technologies for dimensional measurements and material characterisation with nano-scale resolutions as well as high-speed parallel image processing for inspection applications.

Nanotechnology and miniaturisation trends are re-defining instrumentation and measurement techniques for both established and emerging industries such as healthcare and biotechnology. Higher-resolution measurements of elements like length, time, force, mass and chemical compositions that correspond to sub-micron and nanometric scales are in demand.

The Group carries out collaborative research with academic institutions, co-develops processes and products with companies, transfers technology and conducts training for the manufacturing industry.

Core Competencies

- **Optical Measurement**

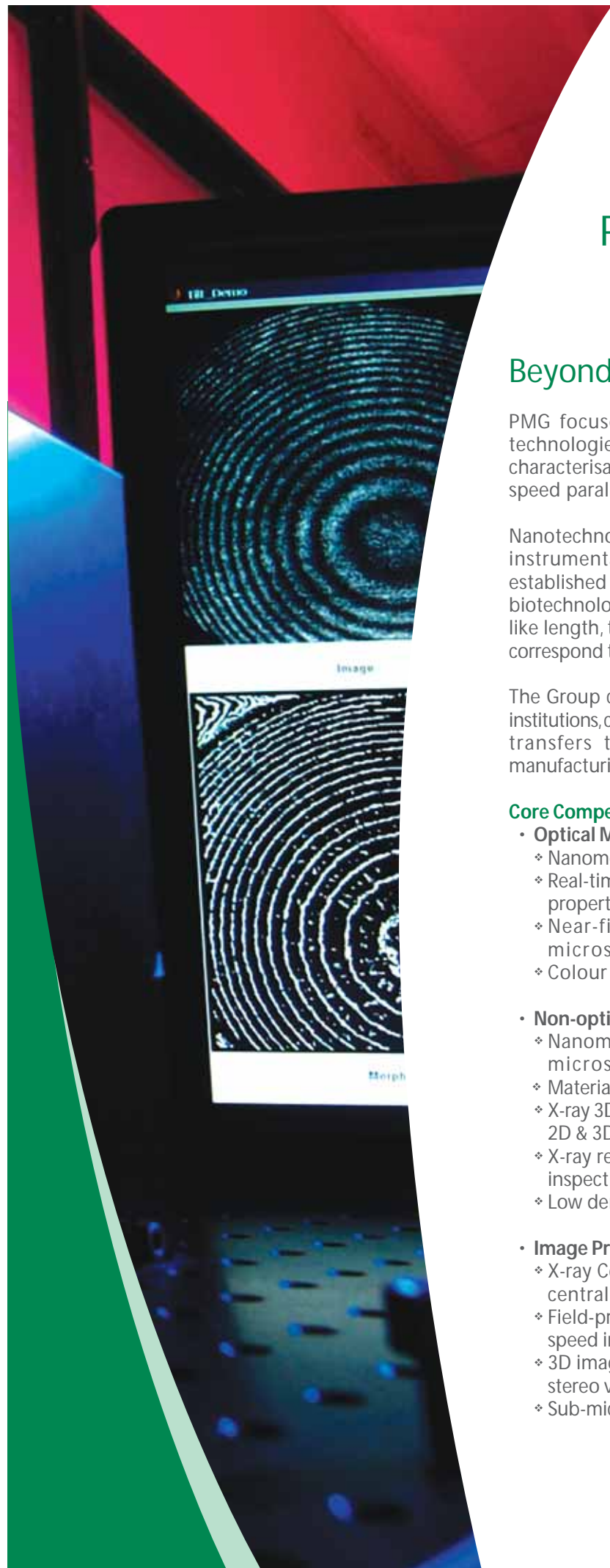
- ❖ Nanometric Interferometry for 3D profiling
- ❖ Real-time wavefront sensing for 3D surface and optical property measurement
- ❖ Near-field optical imaging and photon emission microscopy for semiconductor failure analysis
- ❖ Colour imaging for wafer surface defect inspection.

- **Non-optical Measurement**

- ❖ Nanometric measurements with scanning tunnelling microscope & atomic force microscope (AFM)
- ❖ Materials characterisation and testing
- ❖ X-ray 3D computed tomography and laminography; In-situ 2D & 3D sub-surface inspection
- ❖ X-ray refraction for composite material internal damage inspection
- ❖ Low density material X-ray imaging and characterisation.

- **Image Processing**

- ❖ X-ray Computed Tomography (CT) reconstruction; X-ray central ray calibration; CT image slicing and analysis
- ❖ Field-programmable Gate Array (FPGA) accelerated high speed imaging and processing
- ❖ 3D imaging and reconstruction using phase shifting and stereo vision
- ❖ Sub-micron automatic defect detection and classification.



Technologies Available for Transfer

- 3D wafer bump inspection system
- 3D wirebond inspection system
- Fast automated centre-of-rotation determination in X-ray CT system
- Fibre displacement measurement sensors
- Fibre vibration measurement sensors
- Fibre-Bragg-Grating (FBG) Technology
- Inspection system for nickel sulfide inclusions in toughened glass panels
- Interferometry system for fibre end face inspection
- Interferometry system for microlens array inspection
- Laser tilt sensor
- Media surface inspection system
- Moiré fringe technique for 3D inspection
- Needle inspection system
- On-the-fly BGA inspection system
- Optical interleavers/ de-interleavers
- Portable Precision Module for Interferometry (PMI)
- Scanning near-field optical microscopy (SNOM)
- Super-luminescent Light-emitted Diode (SLED) spectrum equaliser
- Stem cell culture monitoring system
- Wafer/ Liquid Crystal Display (LCD) surface defect inspection
- Wavefront sensing for inspection aspherical lens measurement
- Wavefront sensing for real-time wafer flatness measurement
- X-ray computed tomography (CT) and visualisation
- X-ray computed tomography (CT) for multi-layered object
- X-ray internal structure defect inspection.

Target Industries

- Aerospace • Biomedical • Electronic manufacturing
- Optoelectronics • Precision Engineering
- Semiconductor

Major Facilities

- Advanced metrology equipment: scanning probe microscopes; nano-indentation system; multi-sensor coordinate measuring machine; laser interferometer; spectroscopic ellipsometer
- Material characterisation: scanning electron microscopes and energy dispersive spectrometers; X-ray diffractometer; fourier transform infrared spectrometer; spectrophotometer; differential scanning calorimeters; thermomechanical analyser; dynamic mechanical thermal analyser; rheometers; tribometer; adhesion scratch tester
- Testing and analysis: universal testing machine; fatigue and creep tester; X-ray inspection machine; X-ray fluorescence, micro-hardness tester; optical microscope system.



Industry Partners

- Advanced Micro Devices (S)
- Advanced Packaging Solutions
- Advanced Systems Automation
- AEM-Evertech
- Beyonics Technology
- Component Technology
- Delphi Automotive Systems
- Generic Power
- Hewlett-Packard
- Hypertronics
- Leica Geosystems Technologies
- Manufacturing Integration Technology (MIT)
- Philips Electronics
- Polycore Optical
- Possehl Electronics
- PSB Corporation System & Automation Centre
- Rolls-Royce
- Seidensha
- Semicaps
- Singapore Safety Glass
- Semiconductor Technologies & Instruments (STI)
- Thales High Tech Optics.

Research Partners

- Bioprocessing Technology Institute (BTI)
- Georgia Institute of Technology (USA)
- Institute of High Performance Computing (IHPC)
- Institute for Infocomm Research (I²R)
- Nagoya Institute of Technology (Japan)
- Nanyang Technological University (NTU)
- National University of Singapore (NUS)
- Tianjin University (China)
- Wuppertal University (Germany).

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