

MEMS Test & Characterisation Laboratory

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Introduction: MEMS at Tyndall

The term Microelectromechanical Systems (MEMS) broadly describes the use of IC fabrication techniques to create micron-scale, free-standing and often movable sensors, actuators and transducers. Tyndall can offer a full toolkit of MEMS processing facilities to the Irish academic researcher as part of the National Access Programme; these capabilities encompass a wide range of fabrication techniques ranging from surface micromachining and bulk etching to plating and wafer bonding.





Reflecting the multidisciplinary nature of the subject, MEMS scientists at Tyndall are drawn from a number of complementary research groups, spanning the fields of physics, mechanical engineering, microelectronics and computer science. Together with our academic and industrial partners, we aim to develop micromechanical devices and systems for applications in telecommunications, biomedicine and sensing technologies. Examples of our current research include radio-frequency components for next-generation telecommunications, microneedles for painless drug delivery, wireless environmental sensor nodes and miniaturised spectrometer development. These research and fabrication capabilities are backed up by a full suite of state-of-the art characterisation tools in our MEMS Characterisation Laboratory, where electromechanical, radio frequency, optical and environmental assessment of MEMS devices is carried out.


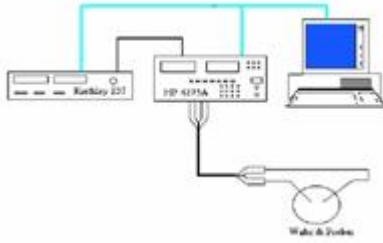
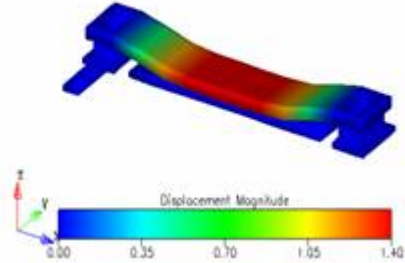

MEMS Characterisation Laboratory

Reflecting the multidisciplinary nature of the technology, the MEMS Characterisation Laboratory at Tyndall is equipped with a range of for tools for optical, electromechanical, radio-frequency and environmental measurement of micromechanical devices. Both wafer- and die-level characterisation is possible under a range of atmospheric and environmental conditions.

Some examples of current laboratory activity include topography measurement of contacting surfaces, on-wafer radio-frequency characterisation of surface micromachined varactors, assessment of the effects of temperature and humidity on dielectric charging in RF switches, evaluation of environmental sensor performance and examination of the switching speed and resonant frequency of electromechanical actuators.

Equipment: Information on the specific equipment available in this laboratory is outlined below

Polytec MSA-400 Micro Systems Analyser	Zygo NewView 5022 white-light interferometer	Agilent E8361A/N5260A Network Analyser	Benchtop Climactic Chamber
			
<p>The Polytec MSA-400 is a state-of-the art system for static and dynamic analysis of MEMS and microstructures</p> <ul style="list-style-type: none"> ▶ Out-of-plane motion up to 30MHz using laser vibrometry ▶ In-plane motion using stroboscopic imaging ▶ Topography analysis with a vertical resolution of 1Å 	<p>The NewView 5022 is a white-light interferometer for surface profiling and thin film analysis</p> <ul style="list-style-type: none"> ▶ Vertical resolution is 1Å ▶ Research applications include: <ul style="list-style-type: none"> § Static & dynamic structural characterisation § Thin film thickness & surface roughness analysis 	<p>The Agilent E8361A/N5260A is a Vector Network Analyser capable of performing radio-frequency measurements to 110GHz</p> <ul style="list-style-type: none"> ▶ Used in conjunction with a low-loss Cascade RF probe station ▶ Temperature control: -55°C - +200°C ▶ Radio frequency characterisation used for: <ul style="list-style-type: none"> § Measurement of insertion loss, isolation & return loss of micromachined capacitive switches & varactors § Characterisation of highly miniaturised antennas for wireless network applications 	<p>The Micro MT225 is a benchtop climactic chamber with a chamber volume of 11 litres</p> <ul style="list-style-type: none"> ▶ Temperature range:-70°C to +180 °C ▶ Humidity range:10 to 98%RH ▶ Research applications include: <ul style="list-style-type: none"> § Characterisation & calibration of micromachined environmental sensors § Reliability testing of MEMS

Pressure and vacuum measurement capabilities	Capacitance-Voltage Test Systems	CoventorWare Process Design and Device Modelling Software Suite	Keithley 4200 Semiconductor Characterisation System
			
<p>Custom-built vacuum chambers allow MEMS characterisation at low pressures</p> <ul style="list-style-type: none"> ▶ Wafer-level test capabilities available ▶ Research applications include: <ul style="list-style-type: none"> § Analysis of micromachined resonators for telecommunications applications § Calibration of micromachined pressure and gas sensors 	<p>C-V (capacitance-voltage) monitoring is used to analyse the electromechanical performance of MEMS</p> <ul style="list-style-type: none"> ▶ Vertical resolution is 1Å ▶ Commonly used for: <ul style="list-style-type: none"> § Characterisation of switches and tunable capacitors § Extraction of mechanical properties of thin films using pull-in techniques 	<p>Coventorware is the industry-standard simulation tool for MEMS</p> <ul style="list-style-type: none"> ▶ Multiphysics platform that handles combined problems including: <ul style="list-style-type: none"> § Static and dynamic electromechanical simulation § Device design & behavioural Modelling § Process modelling & device layout § Thermal analysis 	<p>The Keithley 4200 is a parameter analyser for advanced microelectronic characterisation</p> <ul style="list-style-type: none"> ▶ Sub femtoamp resolution ▶ Embedded PC provides familiar GUI & instant data analysis ▶ Used in MEMS for: <ul style="list-style-type: none"> § Characterisation of thermal & pressure sensors § Reliability analysis of dielectric thin films

For further details on MEMS research at Tyndall, please contact Dr. Conor O'Mahony or visit www.tyndall.ie/research/mems/