

## *Characterised by Expertise*

Working today with many prestigious clients, Intertek MSG is based at the Wilton Centre in the North East of the UK. Intertek MSG has over 40 scientists, with deep expertise in the characterisation of chemicals, polymers, composite materials, catalysts and other inorganic materials. Formerly the corporate analytical and physical science group in ICI PLC, the group joined Intertek in August 2007 as part of Intertek's wide network of laboratories. In recent years the Group has also applied its skills in areas such as pharmaceuticals, medical devices and flexible electronics, extending its customer base to these sectors. All facilities operate to ISO17025 Quality standards, accredited and audited by UKAS. Our clients are based in many parts of the world and use us for problem-solving and projects, as well as complementing their own measurement facilities with some of the specialised ones we have. Intertek MSG can offer GxP-accredited work from within the network of Intertek laboratories in the UK.

A detailed listing of the technical capabilities of the Group is available, but, speaking more generally, the services that we provide can be broadly categorised as:

### **Consultancy**

Many of MSG's scientists are national or international experts in their fields. We can provide consultancy services ranging from short discussions & advice through to more detailed programmes, including the provision of reports on measurement issues or the supply of expert witness services for product dispute or litigation cases.

### **Materials Research Projects**

MSG also works closely with customers on longer-term projects, often targeted at the development or optimisation of new materials. The MSG materials characterisation, measurement and processing expertise (for example in the area of structure-property relationships) may complement the customer's own synthetic or processing skills. Such projects may be led by either the customer or by MSG personnel.

### **Problem Solving**

In many cases our customers do not have a defined measurement need, but rather have a materials-related problem – for example of product quality, performance or processability. In this case our scientists will consult with the customer and define an appropriate set of measurements in order to investigate the issue. These may often be spread across a number of the Group's teams. Results will be collated and presented to the customer in terms of the solution to the problem posed.

### **Method Development**

MSG scientists have much experience in the development and modification of measurement methodologies, for application to specific customer problems. This has ranged from the adaptation of 'routine' measurements for novel sample types through to major projects on the development of on-line measurement tools or the design of screening protocols for high throughput experimentation.

### **Provision of data**

The wide range of MSG's measurement capability is described in the Appendix. Where the customer has specific requirements falling within this portfolio we can give a responsive data provision and interpretation service, whether for single samples or for ongoing QA type needs. The expertise of our scientists means they can interpret the results obtained in the context of the customers' products or processes. Measurement methodology can be customised if necessary to meet specific customer requirements.

It should be clear from the above, that whilst MSG has skills in a wide range of analytical techniques, our strength derives from the ability to combine an appropriate set of measurements for any given situation. Examples of areas where this combination approach has been developed to give us specific expertise include:

### **Deformulation & Reverse Engineering**

The ability to “pull apart” a chemical formulation is crucial in many applications – from quality assurance to competitor analysis. This is a core competency of MSG, with the combination of methods such as XRD, NMR, Mass Spectrometry and Separation Science providing a powerful resource, enabling us to determine the components present in complex chemical mixtures or highly formulated materials.

### **Chemical Imaging**

MSG has invested heavily to augment our capabilities in chemical imaging over recent years. In general, the techniques allow us to build up a chemical ‘map’ of a material surface or interior, where each spatial element of the image contains detailed information on chemical composition – for example in the form of a full infrared spectrum associated with each point. These methodologies generate unprecedented quantities of information which can be presented visually, allowing for detailed studies of sample heterogeneity, active ingredient disposition, contamination distribution or any other aspect of material composition. Available methods include Global Infrared Imaging, Raman, SIMS and XPS imaging and confocal microscopy, as well as element mapping by EDX using SEM and TEM.

### **Structure-Property Relationships**

MSG has the ability to study the structure of materials at all levels – from molecular (using methods such as NMR or Mass Spectrometry), or polymeric (including chain length, molecular weight etc) through to micro- or macro-scale morphology (using a wide range of microscopy methods). We can also characterise physical properties ranging from strength and toughness to optical or electrical properties. A strength of the Group is the ability to combine these skills and apply them to the development of understanding of the changes in structure or formulation that are required in order to achieve a particular desired physical property. A topical example would be in the understanding of the effect of the addition of nanoparticulate fillers to a polymer composite material. Here MSG is able to characterise all aspects of the problem, including the structure and size distributions of the fillers, how they are distributed within the composite matrix, the impact that their presence has on the processability of the composite, and the whether or not they have an advantageous effect on the final physical properties.

### **Failure Analysis and Investigation**

The MSG team focuses on Failure Investigation of polymers, blends, compounds, films, laminates, advanced materials and composites and, particularly, the end-user products manufactured from these materials. One of the key factors in the team's success is their intimate knowledge of raw material production processes, polymerisation technology, moulding processes and end-user applications that vary from simple packaging films through consumer goods to advanced aerospace materials.

### **REACH and Regulatory**

MSG can assist in ensuring that our Clients comply with the new REACH legislation requirements in Europe or with regulations governing the use of packaging and plastics in a variety of application areas, such as food and drug contact. Advice, consultancy and analytical measurements are available from Intertek to provide this support to our Clients.

# Appendix

MSG's technical capability is organised into a number of small teams, each focused on one area of expertise. These are described in detail below.

## **Spectroscopy & Imaging**

### **a) Vibrational Spectroscopy**

- FTIR spectroscopy (Rapid-scan and step-scan)
- Wide range of IR sampling techniques including internal reflection, external reflection, photoacoustic, diffuse reflectance, microscopy)
- Raman spectroscopy (dispersive, lasers@ 532 nm, 633 nm and 785 nm laser excitation))
- Raman spectroscopy for process/in-situ analysis (reaction/reactor monitoring)
- Raman Microscopy and Mapping: production of chemical images with 1 micrometre spatial resolution
- FTIR Microscopy and mapping: analysis with ~ 10 micrometre spatial resolution
- FTIR Global Imaging – massively parallel data acquisition, rapid production of chemical images with ~ 5 micrometre spatial resolution
- Variable Temperature and Pressure Studies
- DSC-Raman
- UV-Visible, including transmission, diffuse and specular reflectance measurements
- Chemometric multivariate techniques for analysis
- Surface-specific studies

### **b) Surface Science**

- Secondary Ion Mass Spectrometry (SIMS):
  - Molecular identification of organics and inorganics
  - ppm sensitivity
  - 2d-imaging at 0.2 micrometre resolution
  - high mass resolution ( $m/\Delta m > 10000$ )
- X-Ray Photoelectron Spectroscopy (XPS):
  - High energy resolution, allowing for improved identification and differentiation of chemical functionality
  - High sensitivity, giving detection limits (0.1 atomic %) and fast analysis
  - Monochromated X-ray source resulting in simple spectra and reduced sample damage
  - High spatial resolution allowing for 2-D imaging at less than 10 um resolution
  - Cold-stage giving capability for studying volatiles / liquids

## **Molecular Spectroscopy**

Component identification and quantification in complex mixtures

Reverse engineering of formulations/ products

Additive detection

Coating analysis/ identification

### **a) Nuclear Magnetic Resonance (NMR) Spectrometry**

- Pulsed NMR for liquids
  - -500, 400 and 300 MHz spectrometers
  - -1H, 13C, 31P nuclei (and others upon request)
- Modern 1-D and 2-D data processing

- GPC-NMR
- Access to Solid State NMR

#### **b) Mass Spectrometry (routine and high sensitivity)**

- Hyphenated techniques including GC-MS, LC-MS and GPC-MS
- Headspace GC-MS
- Thermal desorption-GC-MS
- Pyrolysis GC-MS
- Ionisation techniques include: EI, CI, FD, FI, LSIMS, MALDI, ESI and APCI

### **Separation Science**

Quantitative analysis of organic compounds and ions in all types of sample

Smell, taint, volatiles, colour, gas analysis

Air, effluent and soil analysis

Additives in polymers

Polymer molecular weight distribution (GPC)

Fast GC

#### **a) Gas chromatography**

- Gas chromatography (GC)
- Thermal Desorption-GC
- Headspace GC
- Gas chromatography-mass spectrometry
- GC-MS moisture determination

#### **b) Liquid Chromatography**

- High Performance Liquid Chromatography
- Gel permeation / size exclusion chromatography, including aqueous GPC
- High-Temperature Gel Permeation Chromatography
- Analytical preparative scale liquid chromatography
- Derivatisation techniques

### **Inorganic & X-Ray Analysis**

Detection capabilities range from the ultra-trace to minor and major component levels involving quantitative, semi-quantitative or qualitative measurement interpretation modes. Speciation of analytes by chromatographic separation prior to ICP-MS.

#### **a) X-ray Fluorescence Spectrometry**

- Wavelength Dispersive XRF

#### **b) Atomic Spectrometry**

- Dynamic Reaction Cell Inductively Coupled Plasma-Mass Spectrometry
  - Laser ablation
  - HPLC/Ion Chromatography for speciation
  - Microconcentric nebulisation
- ICP-OES (Dual View)
  - Ultrasonic nebulisation
- AAS
  - Flame Pyrolysis for Hg

#### **c) Combustion Techniques**

- Microanalysis (C,H,N,O)
- Macroanalysis (C,S)

- Chemiluminescence (N)
- Microcoulometry (S,Cl)

#### **d) Chemical Techniques**

- Moisture
- Gravimetry
- Metal Assay
- Ion Chromatography

#### **e) X-ray Diffraction**

Expertise in the analysis of both inorganic, polymeric and composite materials:

- Wide angle X-ray scattering (WAXS) of powders, solids and liquids
- phase identification
- texture and orientation analysis in polymer films
- small angle scattering (SAXS)
- capability for diffraction under controlled process conditions (temperature and environment)
- temperature-dependent structure determination
- structural modelling

#### **f) Surface Area/ Pore Volume Measurement**

- BET method with nitrogen

### ***Chemical Analysis & Product Regulatory***

This area assesses regulatory compliance of their products for use in contact with food and potable water and for use in the manufacture of toys and in pharmaceutical packaging and medical applications.

Determination of migration from materials and articles intended to come into contact with foodstuffs. The studies carried out are in support of existing regulations worldwide or in support of petitions for new products. All of the migration studies are carried out according to UKAS requirements. Thus all studies are subject to Quality Assurance auditing and the calibration of equipment can be traced to national standards. Should it be required, migration studies can be commissioned to GLP standard in another Intertek laboratory.

#### **a) Plastics Analysis**

Identification and measurement of a variety of plastics, including polymers, impact modifiers, lubricants, heat & light stabilisers and anti-static agents.

Separation of constituents employing a variety of extraction technologies

Analysis of individual components by a wide range of analytical techniques e.g. Colorimetry, titrimetry, FT-IR, HPLC, TLC, Gravimetry

#### **b) Chemicals Analysis**

- Analytical and Separation Methodologies for identification and quantification of a wide range of products.
- Titrimetric Analysis
- Separation procedures
- Moisture determination

## **Microscopy**

### **a) Electron Microscopy**

- SEM of polymers and inorganics. Analytical capability (EDX). Image analysis to provide quantification of images.
- Environmental SEM. Analytical capability (EDX) Wet STEM
- Cryo-SEM for soft or wet samples
- TEM, also of polymers and inorganic materials. Microanalysis capability (nm resolution)
- AFM
- Structural modelling as an aid to interpretation

### **b) Optical Microscopy**

- Reflection & Transmission Optical Microscopy
- Confocal Scanning Light Microscopy
- Image Analysis - particularly as applied in production environments
- Determination and modelling of optical properties of films and surfaces, such as gloss, haze, clarity etc.
- Colour determination and analysis

### **c) Contamination Analysis**

- Analytical Microscopy, particularly as applied to process and product problems.
- Contamination audits and consultancy
- SEM-EDX

## **Physical Properties**

### **a) Thermal Analysis**

A wide range of thermal analysis methods are applicable to the investigation of thermal stability, physical properties, structure-property relationships, process history etc.:

- Differential Scanning Calorimetry (DSC) and modulated-DSC
- Thermogravimetry (TG ):
- Thermomechanical Analysis (TMA)
- Dynamic Mechanical Analysis (DMTA)
- Dielectric Thermal Analysis (DETA)
- hot stage microscopy

### **b) Particle Sizing**

- Light scattering methods, as applied to solutions and dry powders
- High-resolution Particle-sizing Disk Centrifuge for Nanoparticles
- Image analysis on optical and electron microscopy images
- Consultancy on On-line and at-line approaches

### **c) Misc. Physical Properties**

- Surface energy measurement
- Contact angle determination
- Wetting studies

### **d) Electrical Properties**

- Determination of electrical parameters of solids and liquids, over the temperature range -100°C to +300°C:
  - volume resistivity

- surface resistivity
- dielectric permittivity and loss
- dielectric spectroscopy
- Electrostatics troubleshooting, charge mapping and charge decay measurements.

### **Materials Properties & Processing**

#### **a) Mechanical Properties**

- stress-strain behaviour characterisation in tension, compression and flexure
- high speed testing
- mechanical testing in environments
- non-contacting extensometry
- tensile dilatometry
- yield stress
- torsional testing
- hardness testing
- pendulum impact testing
- instrument falling weight impact testing
- linear elastic fracture mechanics
- elastic-plastic fracture mechanics
- fatigue testing
- environmental stress cracking
- creep & creep rupture (including under ultra-violet light weathering)
- adhesion tests
- mechanics modelling

#### **b) Fracture Mechanics**

#### **c) Tribology**

- instrumented scratch resistance measurement
- wear studies & abrasion testing
- friction measurement

#### **d) Rheology & Processing (up to 400°C)**

- process simulation
- instrumented injection moulding machine (40 tonne) with fully instrumented spiral flow mould (+ tensile and impact bar moulds)
- capillary rheology – including transient extensional viscosity and laser die swell capability
- rotational rheometry under both controlled strain rate and stress conditions
- Polymer Melt-flow index

**If there is any interest in any of the above services, please address your enquiries to Allan Stewart at the following numbers.**

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