

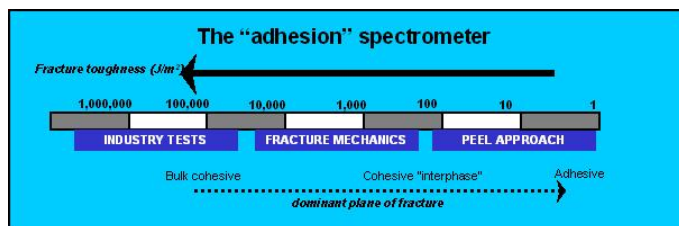
## **ADHESION: Measurement and fracture analysis**

Adhesion measurement is a requirement within many areas of novel materials research and development – but it needs to be resolving – both in terms of physics and chemistry!

Meeting acceptable product performance set down by industry test methods is best achieved by carrying out fundamental adhesion and molecular plane of fracture analysis. Measuring adhesion accurately is key.

Adhesion is a property of fundamental importance in a wide variety applications: laminated manufactured structures, coatings or oxide films on substrates, bonded structures such as automotive or aeronautical components or in commodity adhesives in consumer products and packaging. It can be used to describe the strength with which a component is bonded to a larger structure, or it can apply to the strength of the interfacial bond between microstructural features within that component. Both are equally important.

In order to assist in optimising adhesion bonding in any given system, a wide range of techniques and skills are needed. Measuring the magnitude of a bond strength does not in itself allow for informed enhancements to be made. The topography, surface energetics, surface contaminants or oxides or any curing or setting profile are all critical issues to consider before any study is made. Once a bonded joint or structure has been measured destructively then adhesive fracture forces must be interpreted using associated structural and chemical information along the molecular plane of fracture.

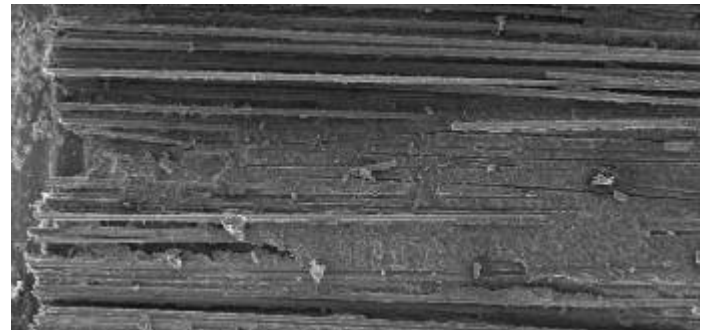


A schematic diagram showing the breadth of measurement capability in Intertek MSG.

**Intertek MSG** is able to monitor and probe many aspects of these, often complex, structures and has much to offer companies that are seeking to improve the effectiveness of new adhesion critical applications.

It works for clients in the pharmaceutical, medical and electronics sectors as well as for those in the personal care, paints, packaging and composites arenas, in addition to its traditional heartland of the chemicals, polymers and plastics industries. Its high-level capability includes instrumentation and expertise appropriate to characterisation and problem-solving in the adhesion area.

Activities within MSG, which are relevant to adhesion and adhesives, are described below.



*Interlaminar fracture in a unidirectional fibre composite, conducted in a fracture mechanics test.*

In addition to standard test methods, **Physical Property measurements** can be conducted using fixed arm or t-peel measurements corrected to give interfacial work of adhesion energy values. Fracture toughness adhesion tests can be undertaken in addition to many international standard methods. Floating roller, climbing drum, mandrel or blister test geometries are also available.

Our capability allows adhesion measurement across a full range of timescales and temperatures. The experience and analytical support within MSG is available to help with the interpretation.

Adhesion screening methods are being developed and patents are pending for **High Throughput Experimentation** work flows, and consultation is on hand in this emerging field.

MSG is actively involved in developing new approaches to apply to the adhesives field through AFM and nano-indentation techniques, and using

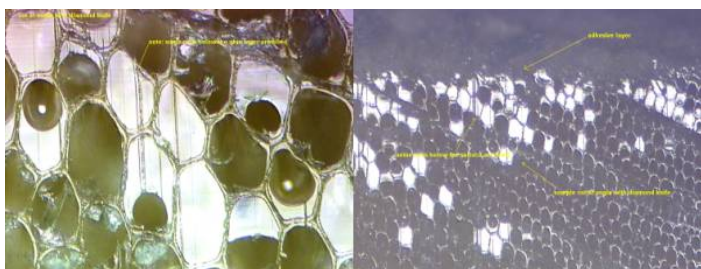
## **Characterised by Expertise**

instrumented scratching techniques to induce delamination in coatings and laminates.



*Measuring the interfacial work of adhesion for a polymer against glass.*

Intertek MSG can offer consultancy, quality control, measurement campaigns or partner your company in a professionally project managed research programme.



*Optical micrographs showing adhesive penetration into a wood joint structure.*

In addition to making direct measures of adhesion bond strength, Intertek MSG has support on hand to help with adhesive polymer chemistry, surface preparation, inorganic analysis and processing expertise.

Through rheological and thermal analysis techniques, adhesives processing and application techniques can all be characterised and advice given.

## Physical and Chemical Analysis and Imaging

State-of-the-art Surface Analysis techniques (**SIMS** and **XPS**) allow for the identification and location of ingredients and contaminants (organic or inorganic) with sub-micron spatial resolution in 2- and 3- dimensions.

Quantitative analysis can be carried out at a point, along a line-scan or through a depth profile. Similarly, imaging using complementary techniques, **Infra-red** or **Raman spectroscopy**, can also probe the distribution of key components.

Dynamic studies of adhesive cure progression is another available method to aid understanding of products and applications.

Analytical Electron Microscopy (**SEM** and **TEM**) can show the distribution of suitable elements as well as the size and shape of the components of the adhesive systems being examined.

Applications include:

- Identification of coating structures
- Surface chemistry
- Thickness measurements
- Distribution of fillers
- Contamination
- Degradation studies

**Adhesion is a multidisciplinary topic that spans a vast array of technologies. Within MSG you will find the broad based technical expertise and wide ranging technical instrumentation that combined are able to offer synergistic, end-to-end solutions for one off problem solving, interdisciplinary projects, or advice with fast turnarounds!**

If there is any interest in the above capabilities, please address your enquiries to Drs Allan Stewart or Isla Mathieson by the following means.

Telephone: +44 (0)1642 435788 or  
Email: [messaging@intertek.com](mailto:messaging@intertek.com)

Intertek MSG  
The Wilton Centre, Redcar, UK, TS10 4RF

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