

ADHESION: Promotion, Optimisation and Control

Good adhesion is a requirement in a wide range of technologies including adhesive bonding, painting, printing, metallising, lamination and composites.

The adhesive or mobile phase, the substrate and often a pre-treatment of the substrate must all be appropriate to achieve the required adhesion.

The basic requirements for good adhesion are:

- Good contact between the mobile phase and the substrate
- Strong interaction between mobile phase and substrate
- Absence of weak boundary layers e.g. contamination, low molecular weight additives

For substrates such as metals and some plastics all that may be required for good adhesion is a cleaning operation. However, the majority of polymers require a pre-treatment or a primer.

Surface preparation is key

The knowledge of suitable cleaning procedures, pretreatments or primers is available through the expertise of individuals within Intertek MSG

The effectiveness of surface preparation methods can be assessed prior to lengthy and perhaps costly product trials. This is done by characterising the surface in terms of its Chemistry and its Topography

Analysing Surface Chemistry

This enables the identification of:

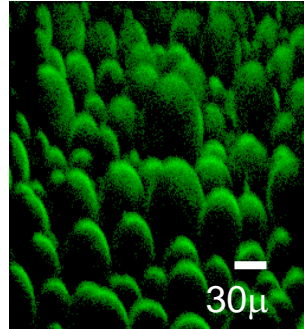
- Suitable primer layers and their coverage
- Correct treatment level e.g. corona treatment
- The removal of contamination

Primer layers can be as thin as only a few nm. Surface analysis techniques such as X-ray

Photoelectron Spectroscopy (**XPS**) or Static Secondary Ion Mass Spectrometry (**SIMS**) are able to

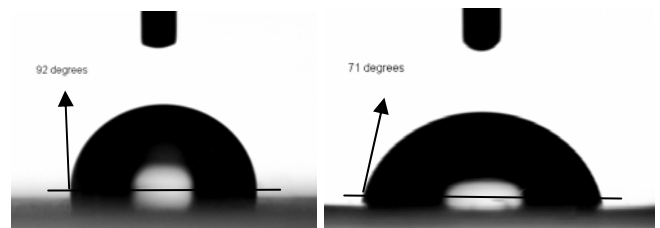
give a specific molecular and quantitative identification of these very thin layers. It may also be possible to distinguish specific commercial brands.

These techniques and expertise are available within MSG with **state-of-the-art** instrumentation



This image is a **molecular image (SIMS)** of a coating just a few nano-metres thick on a polymer bead.

Treatments such as corona, plasma, flame all change the chemistry of the top few nano metres of substrates. This in turn effects the wettability and **surface free energy** which may be assessed using contact angle analysis:



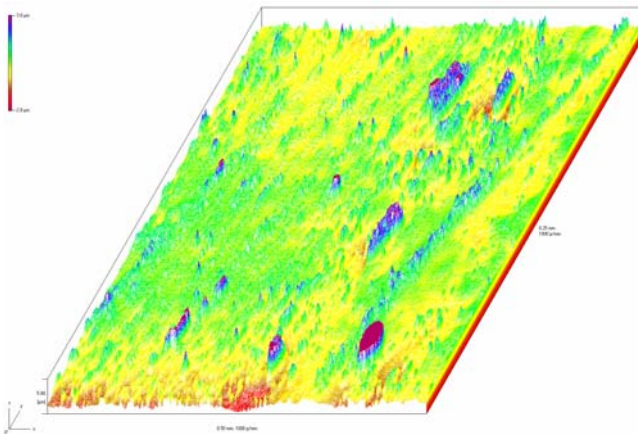
Greater detail on the level of oxidation by such treatments may be obtained from XPS and SSIMS. It is often important to monitor **ageing effects** of treated surfaces. The benefits of pretreatment may be lost over time due to external contamination, additive migration or functional group reorientation.

XPS SIMS and contact angle analysis are all crucial to contamination identification. Substances such as silicones, oils and specific low molecular weight materials can be identified and quantified.

Characterised by Expertise

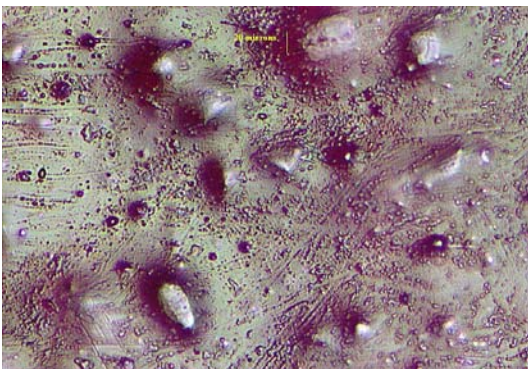
Analysing Surface Topography

A whole suite of topographical imaging techniques are available to determine surface topography from electron microscopy (**SEM and TEM**), Atomic force microscopy (**AFM**), **optical microscopy** and **profilometry**



The image above is a **profilometry** scan of treated polymer surface

Below is an optical micrograph (DIC mode) of a polymer surface with particulates incorporated to alter the surface characteristics.

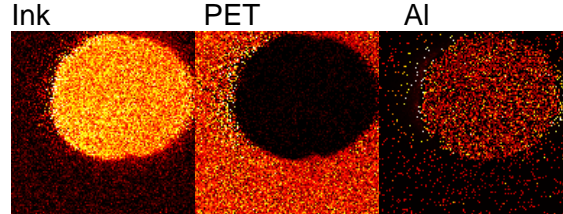


When things don't stick!

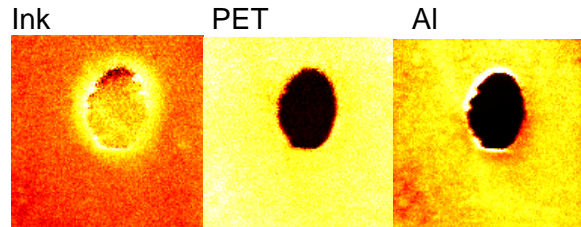
The need may arise to examine failure surfaces, possibly from in-service components. Finding out precisely **where** something has failed is often the key to understanding **why** it failed.

SIMS images of failed printed metallised film showing a mixed locus of failure 500 x 500 µm

Side A of failure



Side B of failure



Adhesion and adhesive strength

The correlation between surface properties and adhesive strength is crucial in development or failure studies. MSG offers a wide capability in adhesive testing, novel design and measurement (see our Adhesion measurement sheet)

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 Allan Stewart or Isla Mathieson by the following means.

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