

How TWI can help SMEs (and the rest of industry)

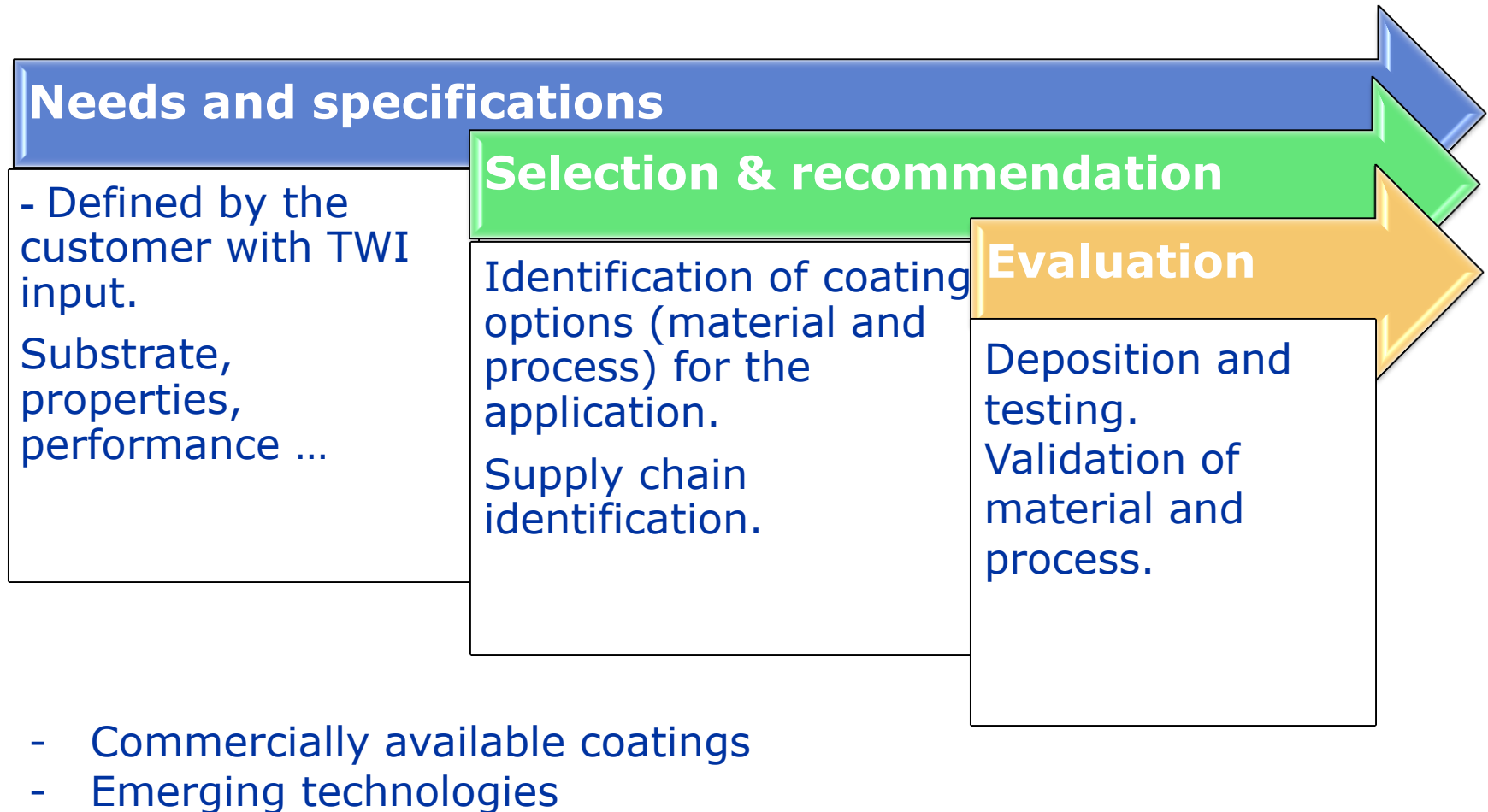
May 2015

Materials Joining and Engineering Technologies

A faint, stylized graphic of a globe is positioned in the bottom right corner of the slide. It shows the outlines of continents and latitude/longitude lines.

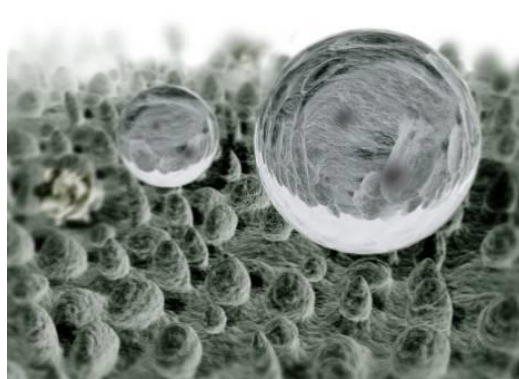
- **Coatings R&D (TRL1-4):**
 - Developing and/or optimising new coatings
- **Applications and pre-production development (TRL4-6):**
 - Solving the practical challenges of transferring a new coating to real components
- **Consultancy:**
 - Coating process / materials selection; troubleshooting and failure investigations
- **Coating characterisation and testing:**
 - Material analysis
 - Wear, corrosion and adhesion testing
 - Development of specialist test methods
 - Includes evaluation of PVD, CVD, electroplating, paint etc
- **Training and technology transfer**

Independent Coatings Selection



Technological Approach

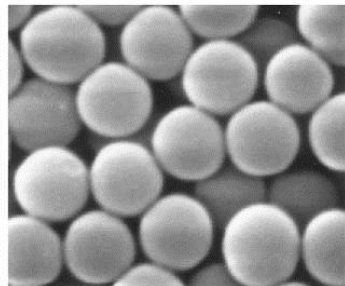
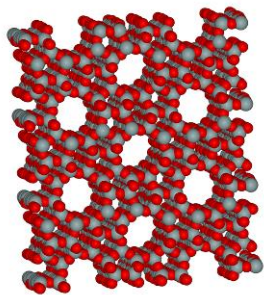
Enabling technologies for functional coatings



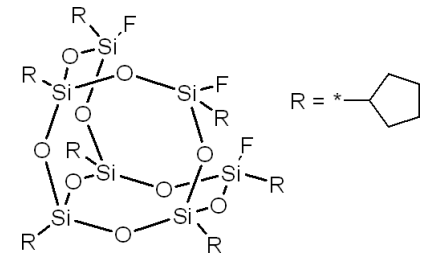
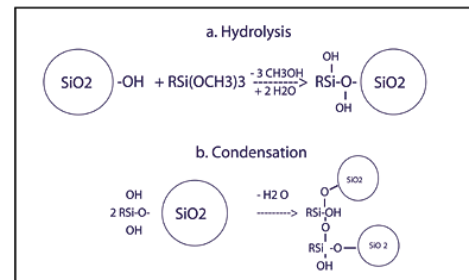
Properties



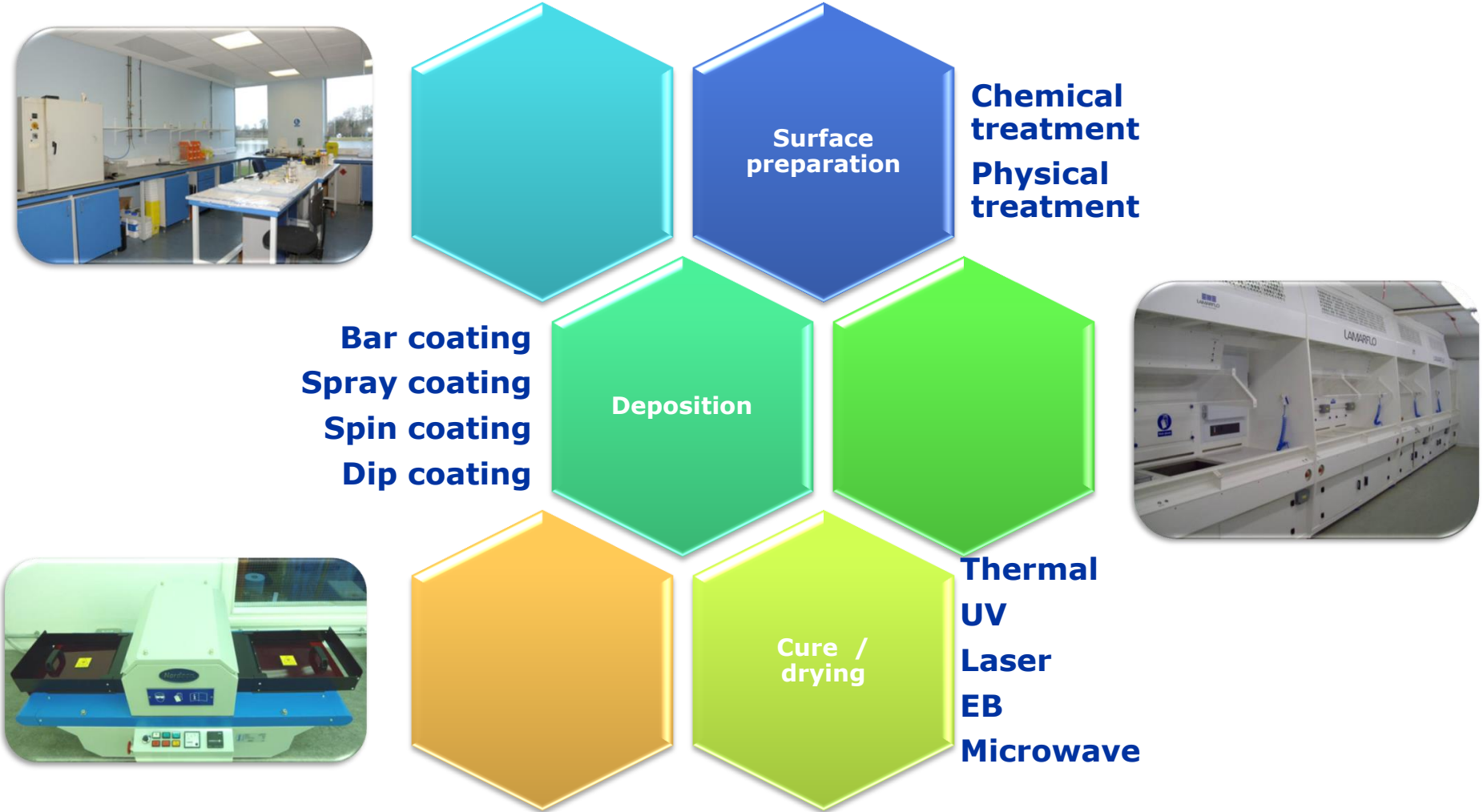
Structure



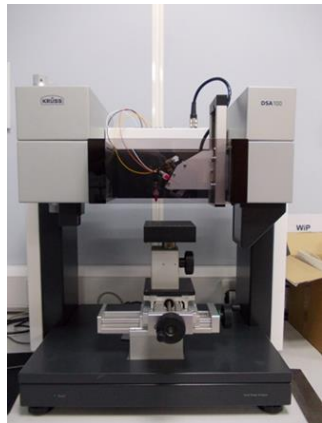
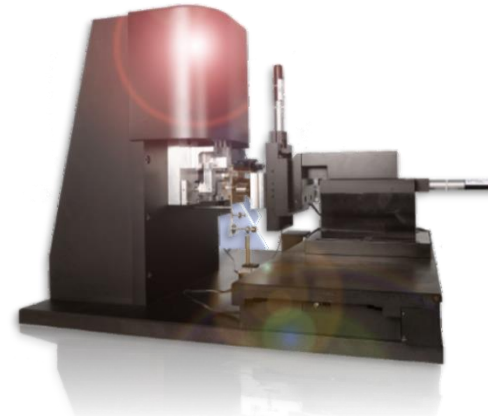
Composition



Coating Process Development



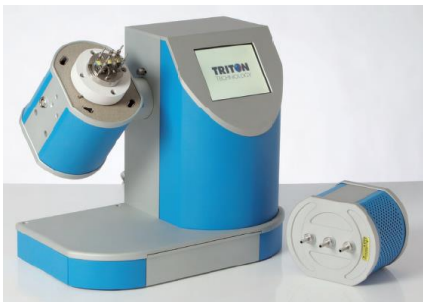
Testing and Evaluation



Analysis Capability

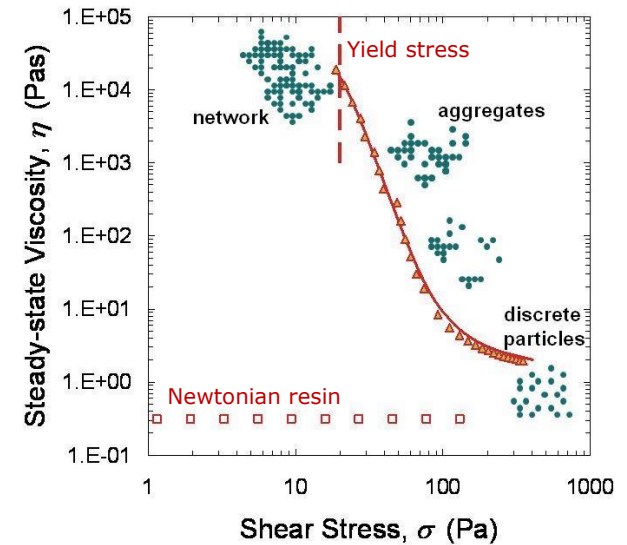
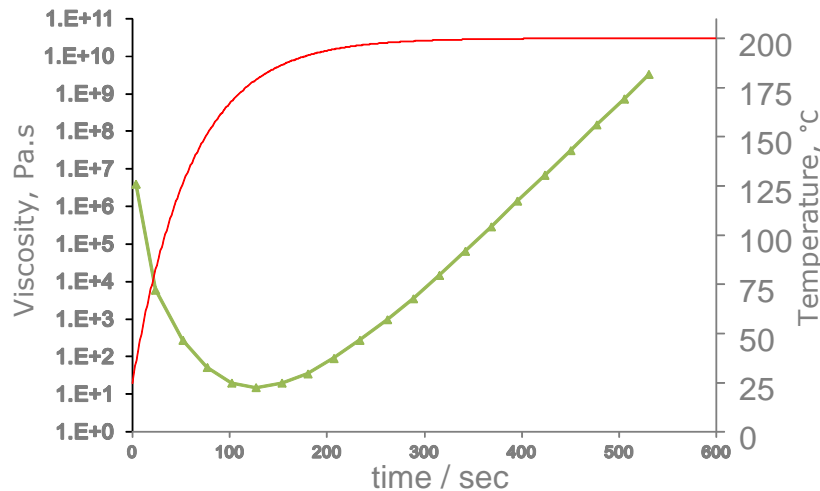
Wide ranging analytical capability including:

- SEM
- Optical microscopy
- Nano-indentation
- Dynamic Mechanical Analysis
- TGA/DSC
- Rheometry
- FTIR
- UV-Vis spectrometry
- Adhesion
- Tensile / compression testing
- Friction
- Wear / abrasion resistance
- Haze and gloss measurement
- Impact performance
- Density



Flow behaviour and cure

- Coating systems tend to be filled, ie a formulation of resins, pigments, actives, extenders etc
- Rheology of the liquid system generates understanding of:
 - Flow behaviour after deposition
 - Curing behaviour
 - Coating life

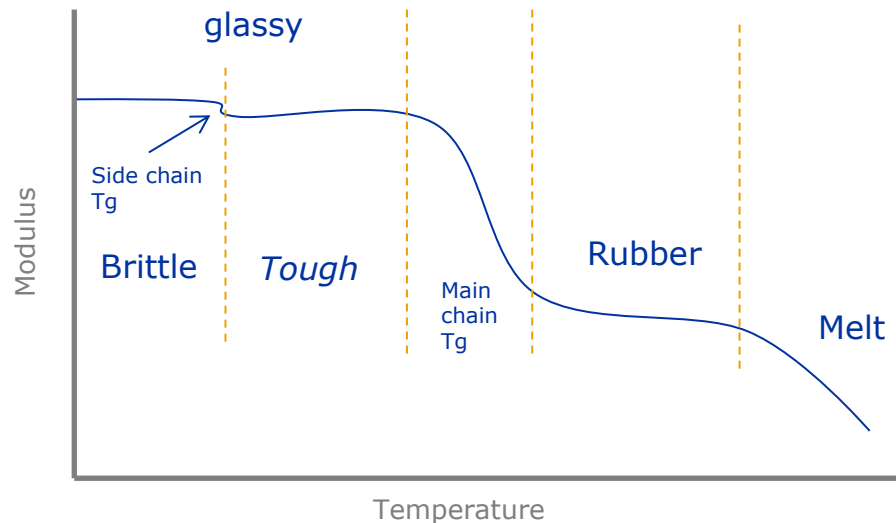


- Rheology can also be used to understand how materials behave with temperature to develop:
 - Assessment of aging
 - Lifing predictions
 - Failure assessment

Mechanical Analysis

DMTA- Dynamic Mechanical Thermal Analysis

- Analysis of curing process and resulting structure
- Able to measure modulus & Tg of film samples, sub-ambient to 400°C



- Provides an understanding of the brittle/ductile nature of a material
- Material selection for different environments
- Failure analysis

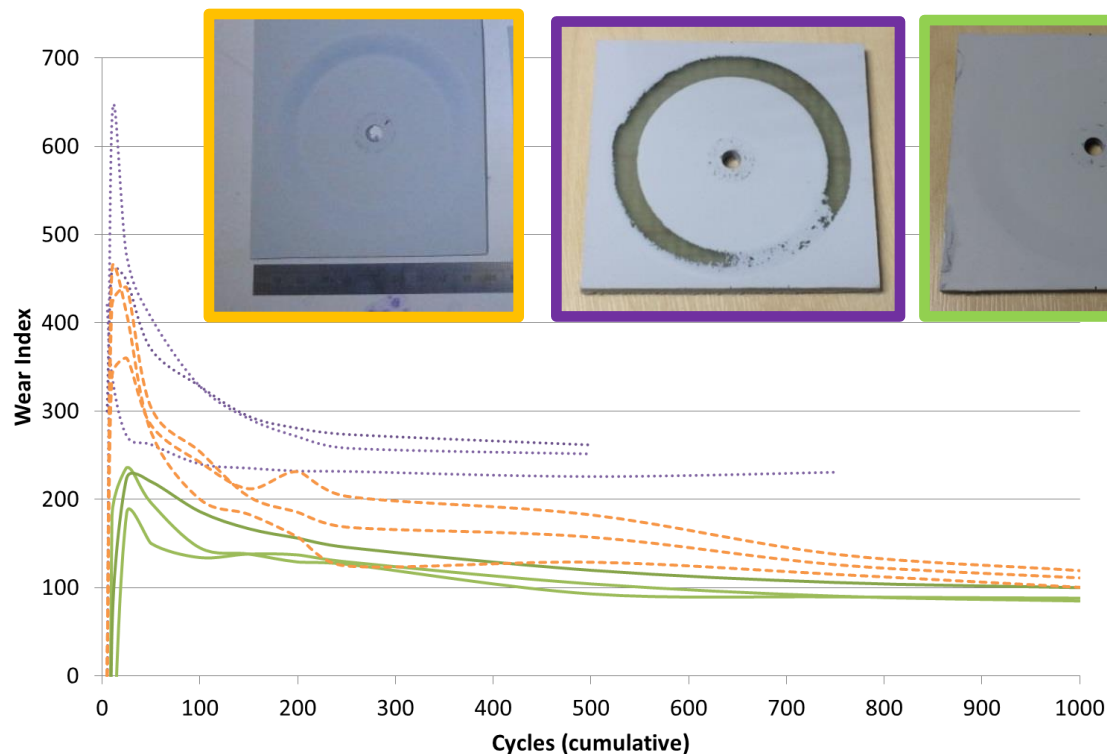
Mechanical Performance - Abrasion

Understanding how a surface wears can lead to the selection of the most appropriate system or development of more abrasion resistant coatings

Base resin

Modification A

Modification B

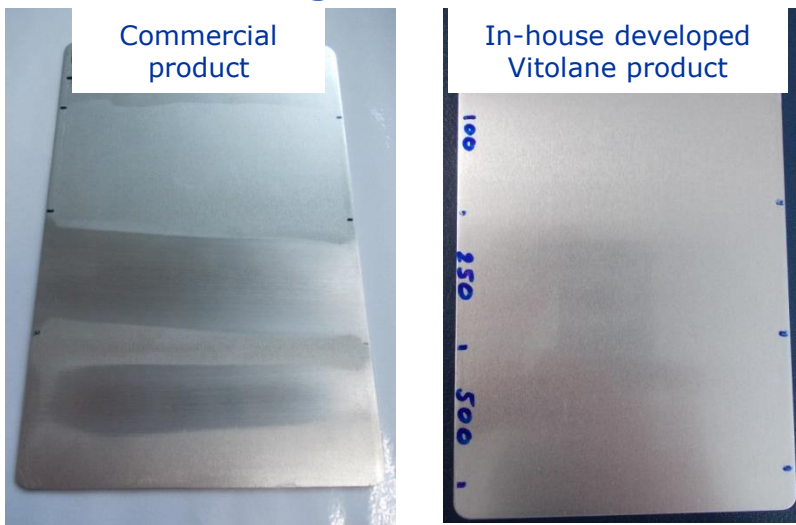


- Quantifiable, repeatable method of defining wear.
- Assessment gravimetrically or visually.

Alternative abrasion measurements

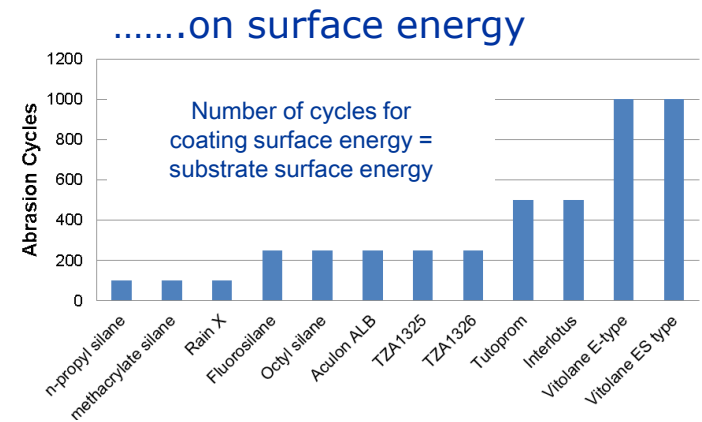
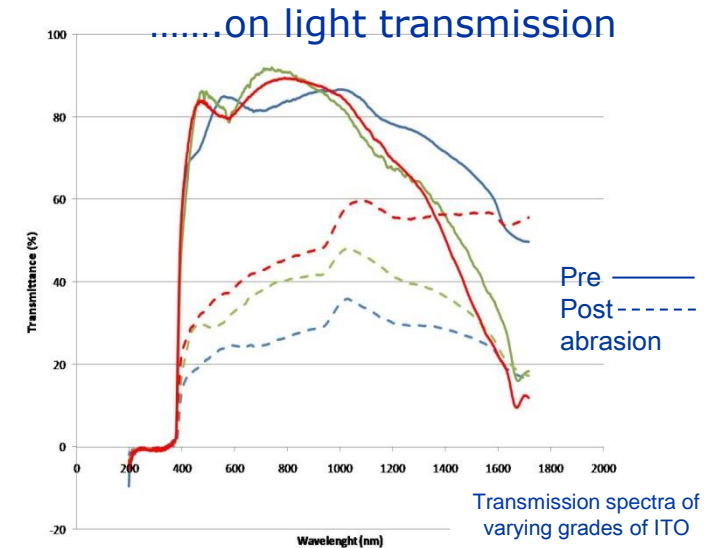
- Abrasion measurement can be adapted to quantify the required parameters

Visual / gloss reduction



Abraded with 0000 wire wool, 100, 250 and 500 cycles

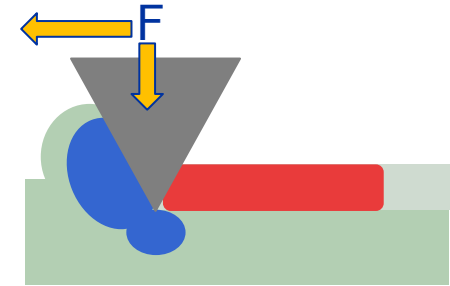
Effect of wear on.....



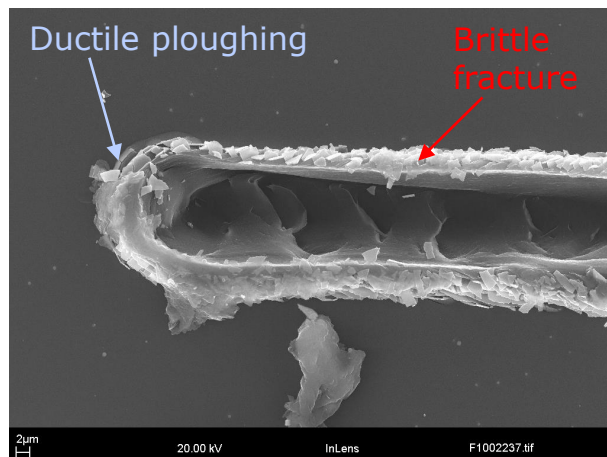
0000 wire wool, 454g load, double rub.
Surface energy measured by contact angle.

Mechanical Performance - Scratch Resistance

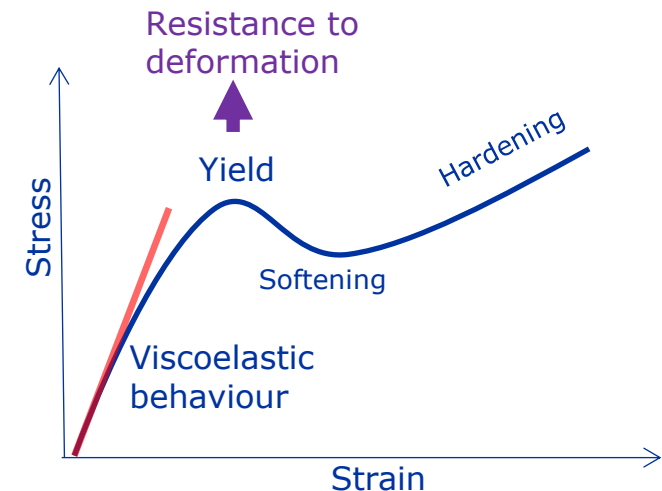
Understanding the compressive, tensile and frictional properties enables development of coatings with improved toughness and scratch resistance.



Compression Tension

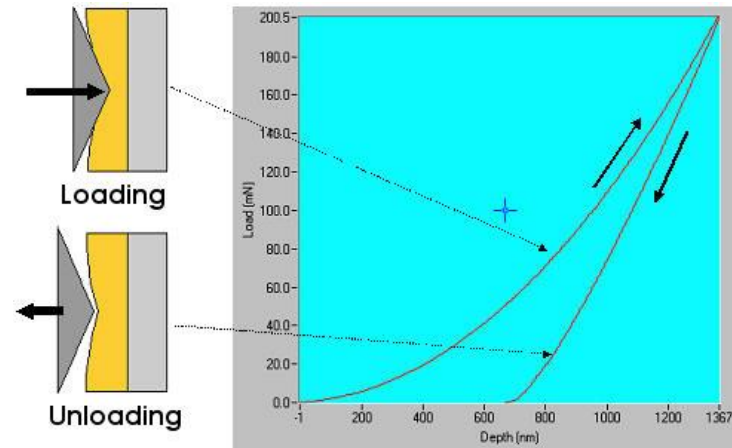
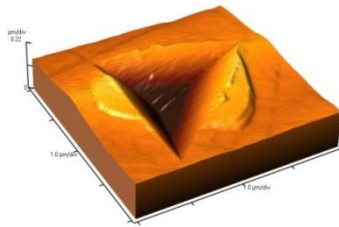


A material can fail in both compressive and tensile modes within a single scratch.



Mechanical Properties - Nanoindentation

- Mapping of surface properties
 - Hardness and elastic modulus
- Profiling of properties with respect to depth
 - Examining the effects of a surface modification process
- Mechanical property measurement of individual phases or grains
 - Creep analysis
 - Nano-scratch and wear testing



The instrument can be adapted to:

- Test under heated and cooled conditions (RT to 550°C)
- Testing in liquid

Corrosion testing:

- ASTM B117 salt spray
- Bespoke testing adapted from bulk material standards
 - ASTM G71 galvanic corrosion,
 - G48 pitting & crevice corrosion,
 - ASTM D6943 chemical immersion,
 - ISO 15156-3 sulphide SCC, ASTM F519 H2 re-embrittlement,
 - Cl- SCC drop evaporation.



Basic ranking of materials

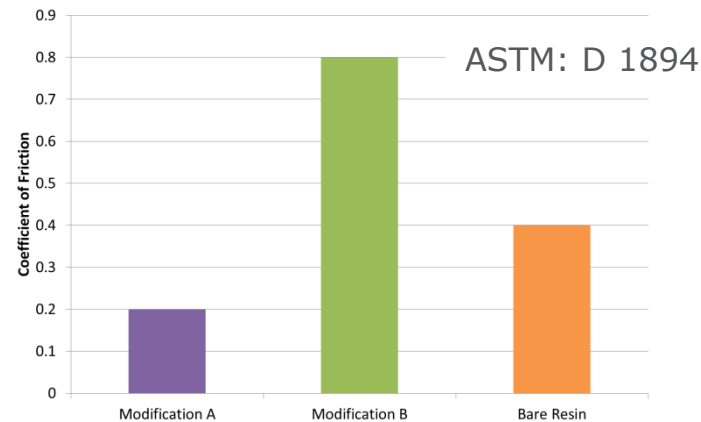


Extending capabilities to



Bruker
Tribolab

Friction / Load sensing	
low range	5 to 500mN
Resolution	50uN
High range	10 to 1000N
Resolution	50mN



Wear	Rotary, Linear, Reciprocating, Abrasive, Fretting, Galling, Seizure
Friction	Static, Dynamic, Stick-slip
Lubricity	Hydrodynamic, Mixed, Boundary
Environmental	Temperature, Humidity, Vacuum, Gases, Corrosive Atmospheres
Scratch	Adhesion, Delamination, Hardness
Indentation	Young's Modulus, Storage Modulus, Hardness
Strain	Multi-axis, Tension, Compression, Torsion, Elasticity, Plasticity, Creep

Direct Support

- Access to equipment and expert analysis capability
- Materials and Process Development available to Members
- Consultancy and Troubleshooting/Failure Investigation available to Members and through regional projects
- All on a confidential, independent, impartial basis



Collaborative R&D Activity

- Identifying industry needs
- Correlating needs to funding calls
- Creating consortia
- Writing and submitting proposals
- Project administration and technical delivery



THANK YOU



If you have any questions please don't hesitate to contact us:

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