NMS Materials Programmes
An Update

November 2003

Background

- Funding for the Materials Measurement programme has transferred to the National Measurement System Directorate (NMSD)
- Best practice will be adopted from NMSD programme formulation and management.
- Re-alignment of programmes.
- NPL and DTI are formulating the first of these programmes now.

What's Happening?

- **Move to 3 'lifecycle' based programmes.**
  - Materials Processing (properties during manufacture)
  - Materials Characterisation (at first use)
  - Materials Performance (in service)
- One programme will start each year
- Programmes will cover all material types
- Will be some degree of overlap between programmes
  - In effect a 'rolling' materials programme
- Funding is likely to be more stable – work may cross programmes

Materials Projects & Industry

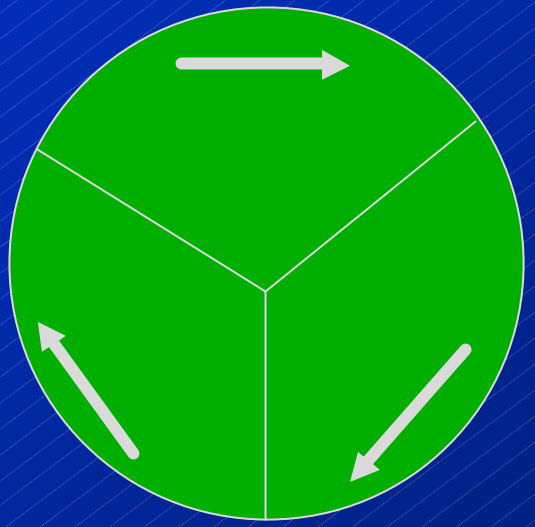
- Must be supported by industry during formulation
- Must attract Industrial Advisory Groups of industry experts
- Must gain material support from industry
- Must produce benefits to industry in the short and long term
- Knowledge transfer a key requirement

Planned NMS Materials Metrology Programmes

Materials Life-Cycle – 3 Programmes of 3 year duration

Measurements for
Materials Processing
manufacturing / fabrication / recycling

Formulate 2004,
work 2005-2008



Measurements for
Materials Performance
service performance/ multi-point data
Whole life costs

Formulate 2003,
work 2004-2007

Measurements for
Materials Characterisation
microstructure / initial properties /
single-point data

Formulate 2005,
work 2006-2009

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Materials Programmes - Formulation Steps

- **Feb-March: Consult with IAGS & key stakeholders to scope programme.**
- **April-June: Wider consultation with industry to rank project priorities.**
- **July: Formulation workshop to confirm priorities.**
- **Aug-Oct: Project prioritisation and specification**
- **Nov: Programme approval at DTI and issue of ITT.**
- **Nov-Feb: Preparation of project proposals .**
- **April: Work starts**

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“Measurements for Materials Performance” 2004-2007

Scope and Aims: “The **Performance of Materials** programme will develop **measurement methodologies** and **models** for the **assessment, prediction** and **ongoing evaluation** of the **properties of materials in a service environment** critical to maintaining fitness for purpose.

Knowledge and best practice will be promoted to users through new facilities, standardised test methods and access to experts.”

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Performance Formulation - Progress

- >95 responses to orientation survey
  - 8 theme areas identified
  - project ideas proposed in each theme
- >160 responses to focussed survey
  - Initial priorities identified
- >80 delegates attended the formulation workshop
  - Priorities and requirements refined
  - Report available at: http://www.npl.co.uk/performance/
- Project priorities and specifications under consideration by DTI

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Performance Programme Themes

- High temperature degradation
- Engineering integrity assessment and assessment monitoring
- Wear and abrasion
- Durability of electronic materials
- Aqueous corrosion & electrochemistry
- Surface engineered solutions
- Performance of polymeric materials
- Construction materials

Accelerated ageing methodologies and predictive modelling well supported but problems specific to materials/environments – projects will address these.

Plastics, Adhesives, Composites, Coatings related projects recommended

- A tool to predict the lifetime of composites
- Non-Destructive Adhesion Measurements
- Accelerated Ageing Protocol For Service in Hostile Conditions
- Sensing the Onset of Damage due to Environmental Exposure
- Permeation, absorption and desorption of liquids and gases in polymer and multilayer systems
- Prediction of the lifetime of polymer welded and bonded joints under long-term loading
- Development of Test Methods for Determining the Criticality of Defects in Composite Materials Systems Under Long-Term Loading
- Adhesives Design Toolkit
- The Performance of Conformal Coatings in Corrosion Protection of Electronic Assemblies
- Abrasion of decorative finishes

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Other Activities

- Studio Projects
  - Short-term, focussed
  - Part funded by companies taking part
- Materials Metrology Tools
  - Fundamental materials measurement techniques
  - Long-term requirements
  - New applications

Future Consultations Remember…….

- Next Programme is Processing
  - Cure, flow, tack, online……
- If you want work addressing your needs then please **respond to the formulation consultations**.
- Work funded will be mainly determined by **what industry supports during consultation.**
- **Make sure your views are heard.**

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A tool to predict lifetime for composites subjected to environmental/fatigue damage

- Homogenisation techniques to extend cross-ply models for general symmetric laminates.
- Use of models to identify properties that need to be measured, and experimental validation
- SmartManual system to create a unique user-friendly design tool for engineers in industry

Degradation of materials through wear and abrasion

- Mainly on hard surfaces and coatings
- Task to examine the feasibility of measuring the degradation of decorative finishes under service conditions

Adhesive Design Toolkit

- Additional module on design and testing for bond durability
- Forensic Analysis

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Non Destructive Adhesion Measurements

- Validation of non-destructive methods for determining non-destructive adhesion
- Guidance on good practice
- Case Studies

Sensing the Onset of Damage due to Environmental Exposure

- Review of current non-destructive test methods
- Evaluation of measurement techniques for detecting environmental damage
- Correlation of measurement data to residual lifetime

Accelerated Ageing Protocol For Service in Hostile Conditions

- Review the relevance of existing accelerated ageing techniques for polymers and composites
- Improvement and development of predictive approaches for the accelerated assessment of the influence of long term loads in combination with aggressive environments
- Validation of experimental procedures for testing programmes as part of the integration with the predictive approaches
- Production and dissemination of a protocol based on current best practice and encompassing case studies

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Permeation, absorption and desorption of liquids and gases in polymer and multilayer systems

- Development of methods for determining diffusion/permeation in polymeric materials
- Evaluation of the influence of environment including load
- Permeation along interfaces

Prediction of the lifetime of polymer welded and bonded joints under long-term loading

- Development of A Model for Predicting Non-Linear Creep Behaviour in Structural Adhesive Joints
- Development of Model for Predicting Cyclic Fatigue Behaviour of Structural Adhesives
- Extension of Non-Linear Model for Use In Predicting Creep Behaviour in Welded Thermoplastics

Development of Test Methods for Determining the Criticality of Defects in Composite Materials Systems Under Long-Term Loading

- Development of Defect Tolerance Test Methods for Long-Term Loading
- Activities Towards Standardisation of Residual Property Test Methods
- Industrial Validation Case Studies

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The Performance of Conformal Coatings in Corrosion Protection of Electronic Assemblies

- Develop an understanding of the measurement issues for determining the protection mechanism and permeability of conformal coatings
- Develop an understanding of the measurement issues for determining the protection mechanism and permeability of conformal coatings
- Develop a test methodology for characterising conformal coating robustness