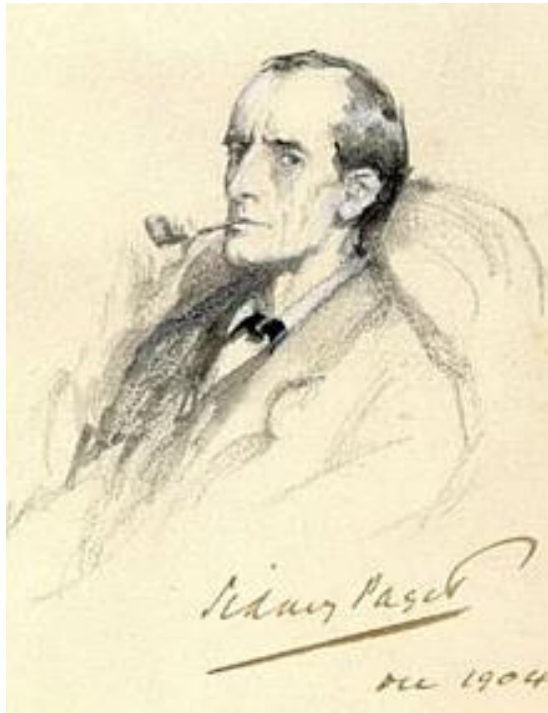


The Use of Forensic Fibre Examinations for Microplastic Studies

Dr Claire Gwinnett, Professor in Forensic and Environmental Science,
Research Lead Microplastics and Forensic Fibres Research Group
@StaffsMicro
Staffordshire University, UK

Outline of Presentation



Outline of presentation and further discussions!

Thinking Points....

- Could this approach aid your microplastic work?
- How does this existing research influence analysis/interpretation methods?
- How does new technology in fibre finding and automated analysis fit into microplastic analysis standardisation?

What is Forensic Fibre Analysis?



al
ove



- Typical
- Many



For the Criminal Justice System it must be:

- * Robust
- * Use standardised and validated approaches – ISO standards
- * Use data to support all decisions

We have (some of) the same questions...

- How much is present?
- What is it?
- Where is it from? How certain are we?
- Where is it going?
- How long has it been there?

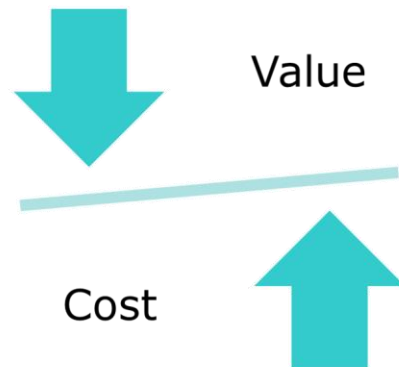


And we have the same requirements....

- Want more data!
- Want the analysis to be quicker!
- Want the analysis to be cheaper!



"Standardised, cheap and simple methods for sorting and enumerating plastic fragments" Thomas Maes, 2017



"Monitoring & Modelling, incl. Distribution and abundance Sources and types Spatial and temporal trends Hotspots" Thomas Maes, 2017

Where can forensic fibre examination processes be helpful in MP work?



INTERPOL

ENVIRONMENTAL SECURITY SUB-DIRECTORATE

**Pollution Crime Forensic
Investigation Manual**

2014

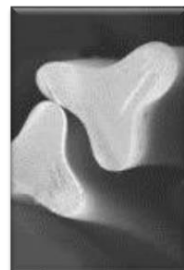
Volume I of II

Overlapping areas: CSI Meets MPs!



Contamination Prevention Procedures

Monitoring of environmental fibre contamination
Fibre free environments/use of Personal Protective Equipment



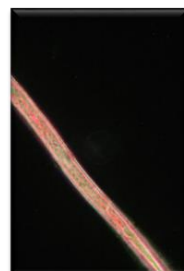
Better Understanding of Source Level

Focus on improved discrimination between fibres
Categorization of samples via use of optical, morphological and chemical properties



Better Understanding of Transfer and Prevalence

Many transfer studies of different garment types
Ability to quantify the sheddability of fabrics
Use of population studies for fibre prevalence in different environments



Faster and More Effective Quantification

Initial polymer identification without use of FTIR
Development of automated systems for fibre characterization and quantification



Improved Interpretation and Evaluation

Collation and use of large datasets
Integrated databases for identification,

Contamination minimisation for microplastic analysis.....



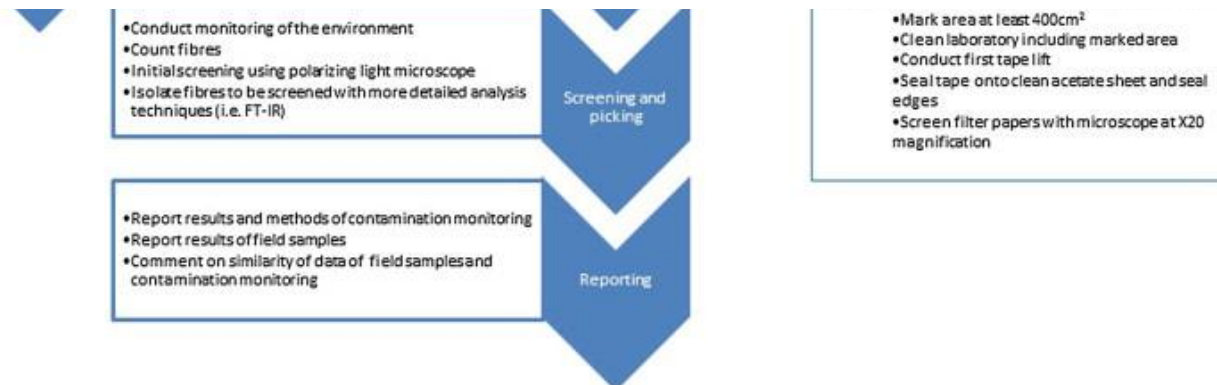
Marine Pollution Bulletin

Volume 95, Issue 1, 15 June 2015, Pages 40-46



Using a forensic science approach to minimize environmental contamination and to identify microfibrils in marine sediments

Lucy C. Woodall ^a  , Claire Gwinnett ^b, Margaret Packer ^a, Richard C. Thompson ^c, Laura F. Robinson ^d, Gordon L.J. Paterson ^a

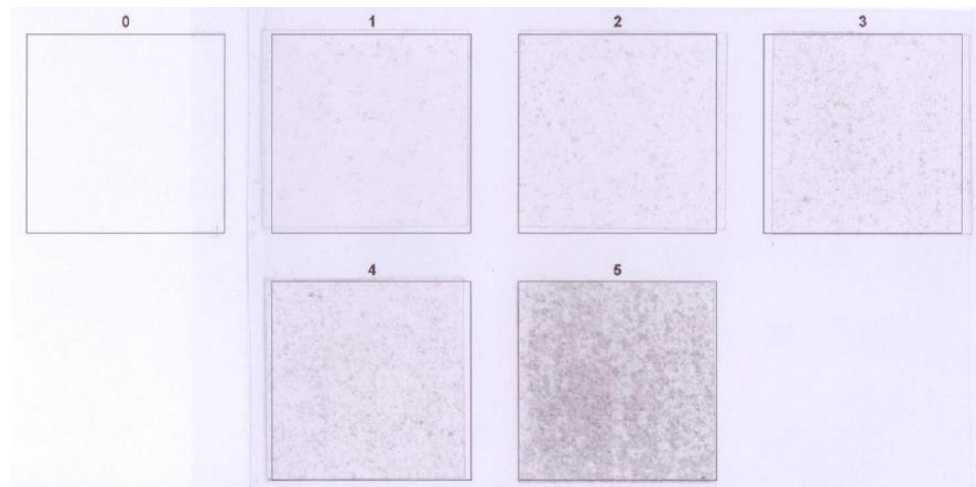


How well do fabrics shed?

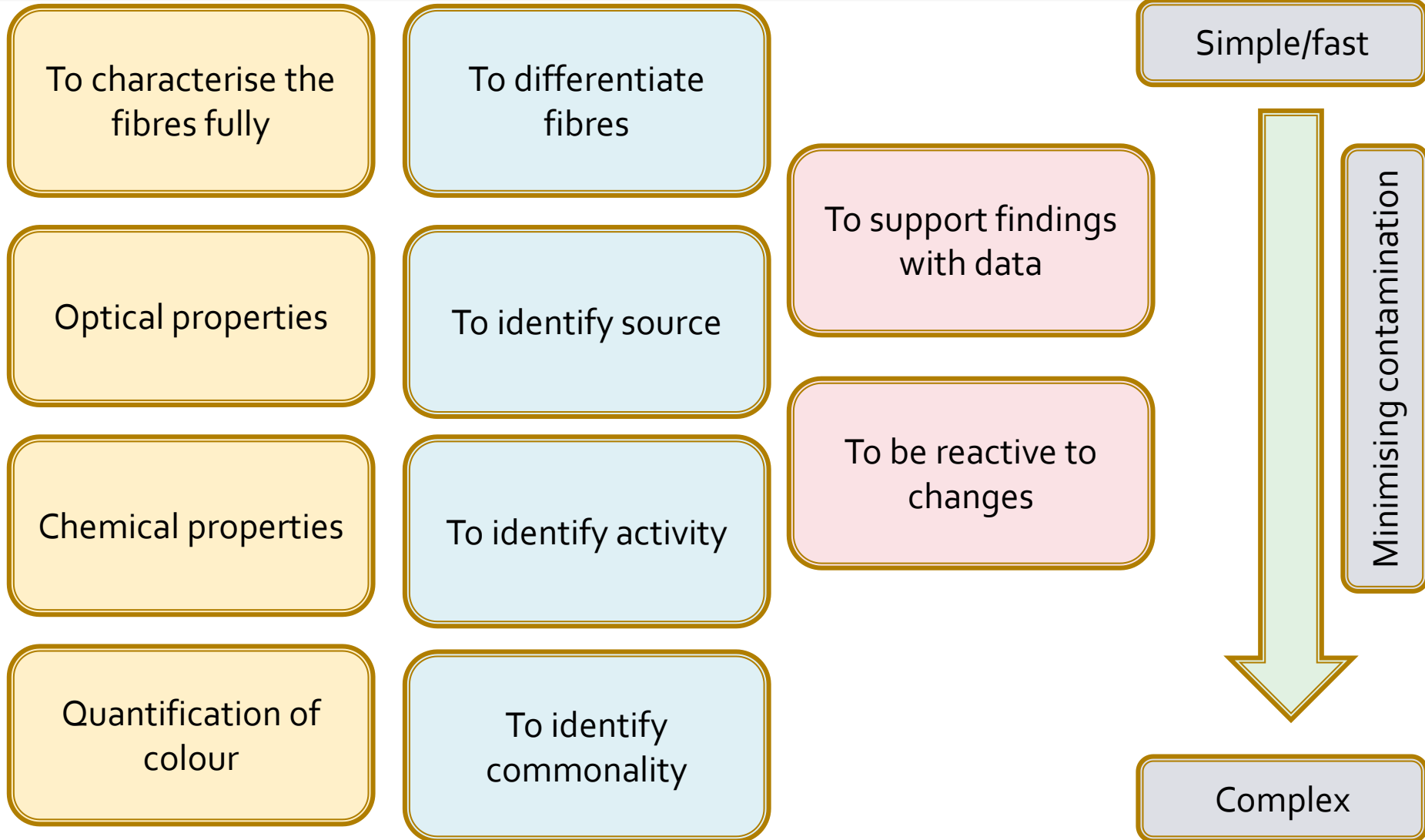
Sheddability of Fabrics in FS

- Helps identify how many fibres could be lost from the fabric to environment
- Dependent upon fabric type, wear, texture, yarn type and number/type of fibres in fabric
- Many fibres shed are fragments broken from surface

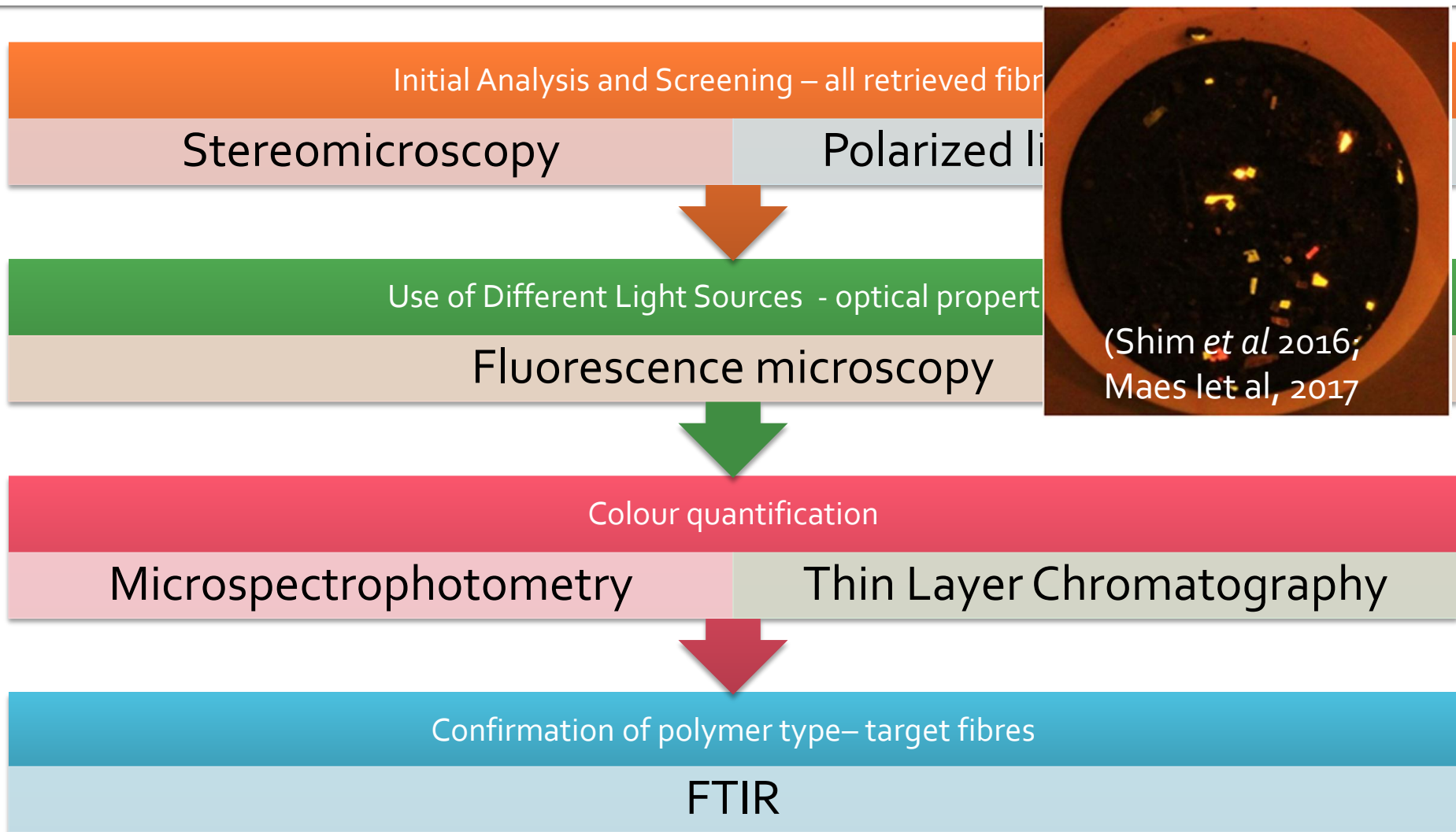
1. Visual
 - Low, medium, high
2. Comparison Scale (Wael *et al* (2010))
3. Controlled force (Robertson and Grieve, 1999, Coxon *et al*, 1992)



Maximising information from MPs

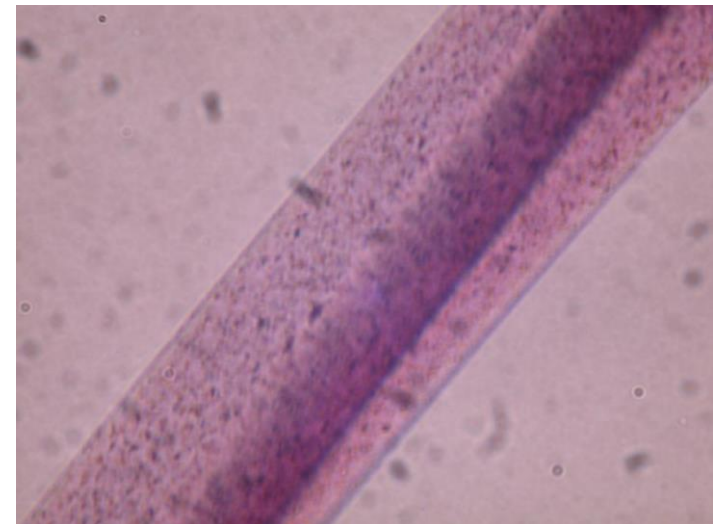


Common Order of Analysis

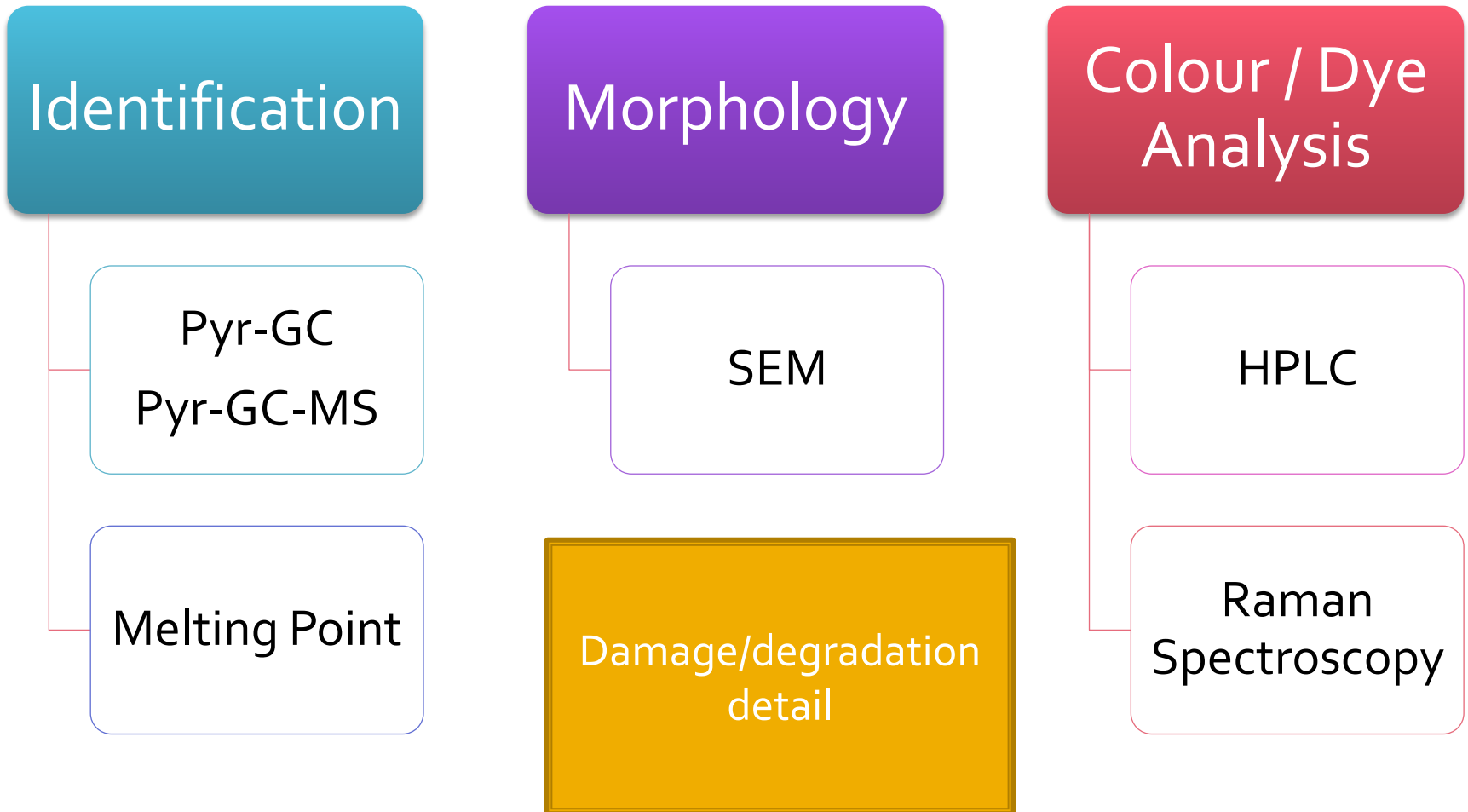


PLM....a great second stage for searching/characterisation

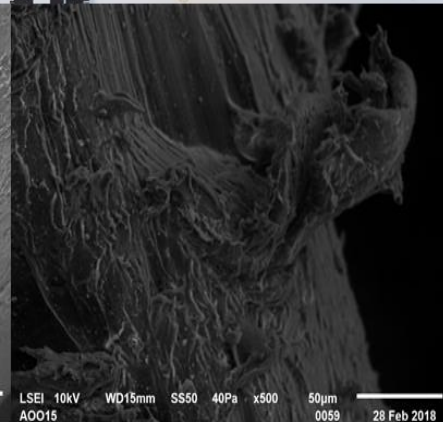
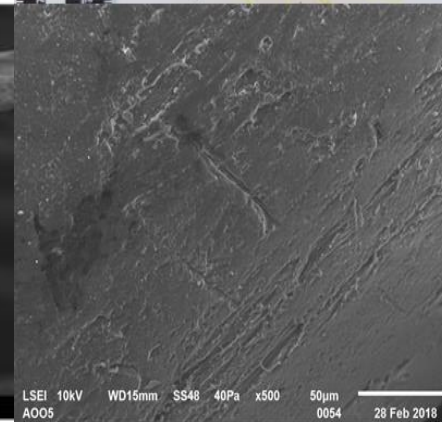
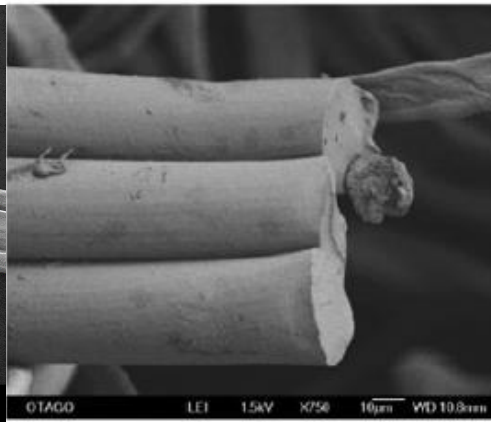
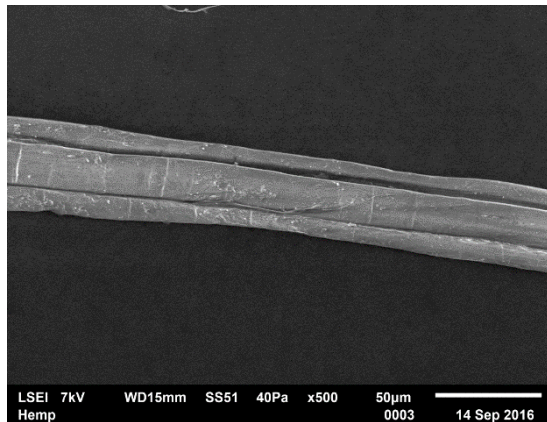
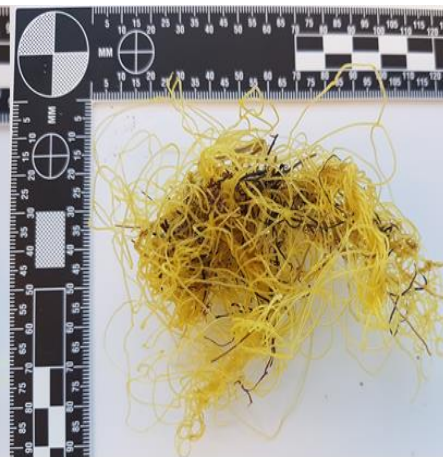
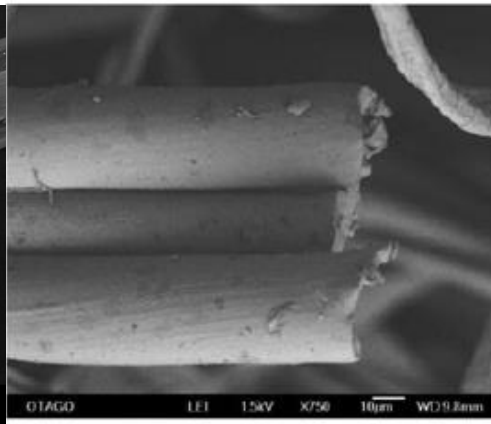
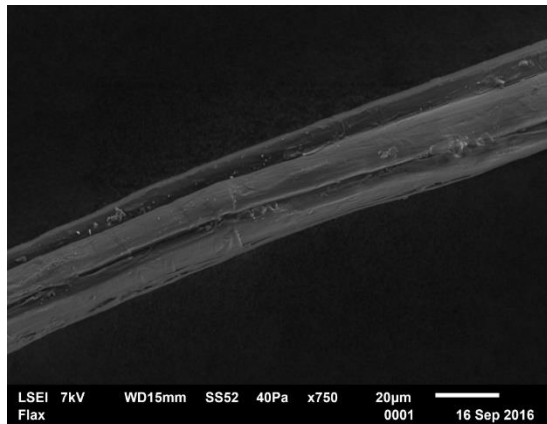
- Added benefits incl.
- Easy ID of;
- Natural vs synthetic
- Polymer type
- Cross-section shape
- Width/length
- Surface area
- Presence of delusterant
- Other inclusions
- Degradation features

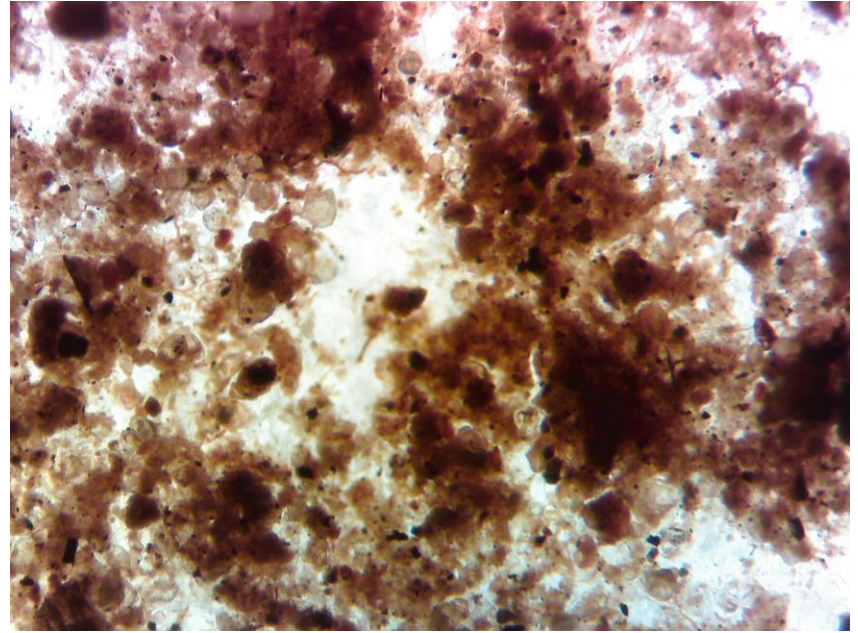
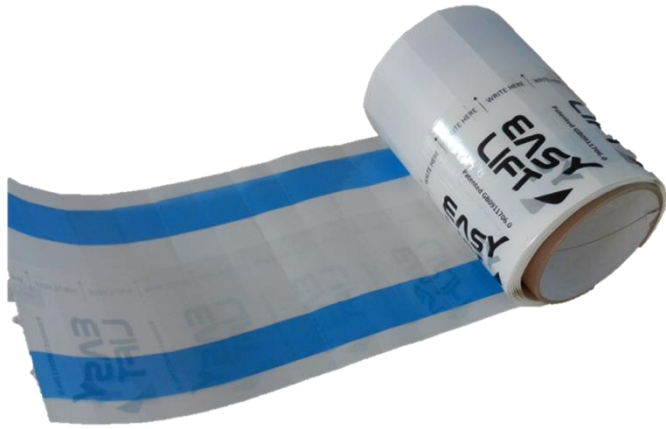


Further Techniques...used to id source level info



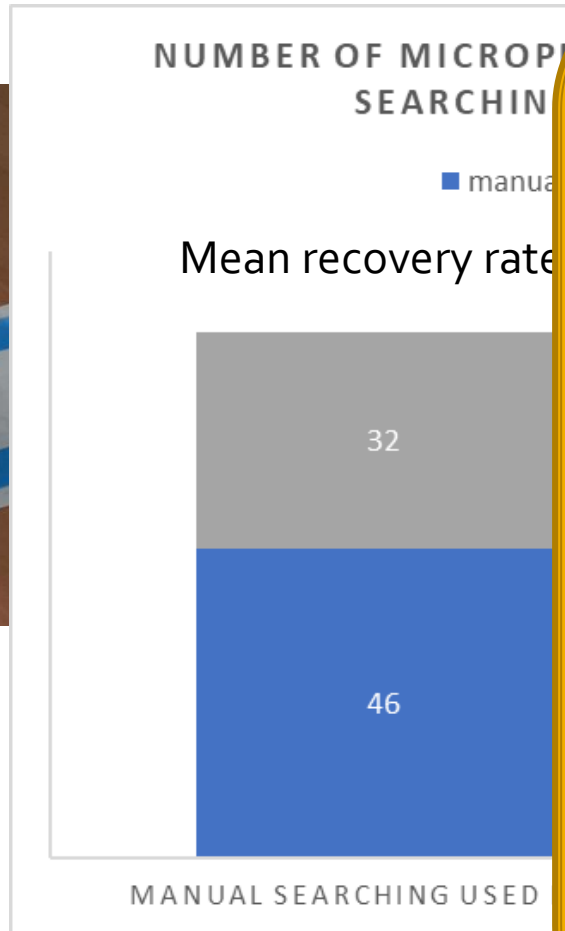
Use of SEM for fibres work





Improved recovery methods

Improved recovery methods



Paper being drafted:

- * Easylift® tape enables effective recovery of microfibrils from filter papers
- * Whatman filter papers outperform glass filters in microfibre recovery
- * Microfibrils may be lost at edges of filter paper during filtering
- * Glass frit filtration recovers more fibres than Buchner filtration from water samples

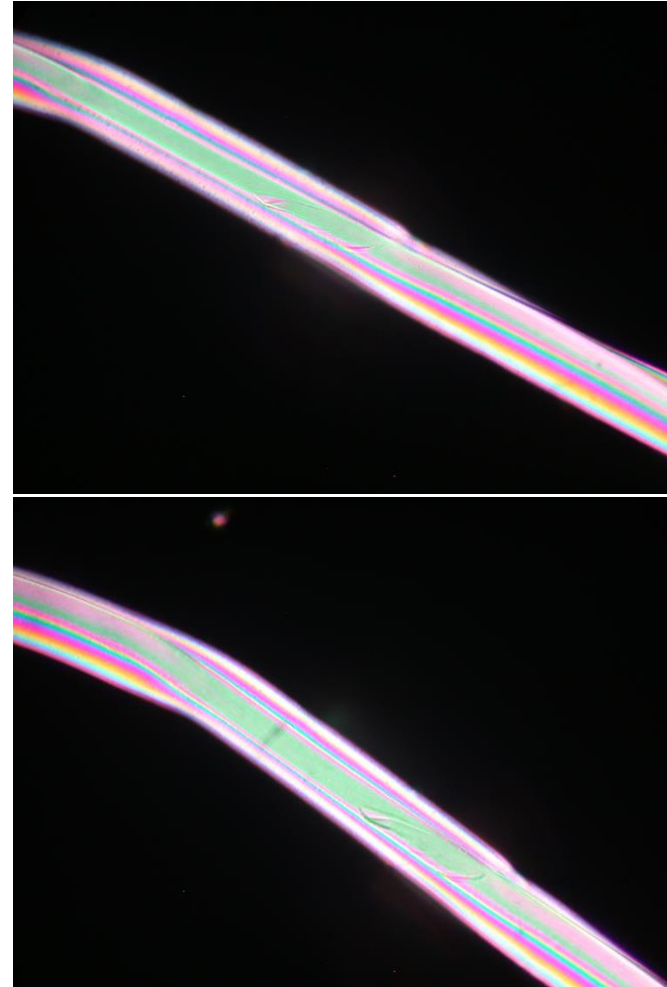
**EASY
LIFT**

patent application numbers
10735037.3 [European] and
13/382208 [USA]

Reducing Analysis Time: Development of Easylift

- + New tape system that allows analysis of fibres *in situ* without need for dissection
- + Non-birefringent
- + Tape and backing does not interfere with analysis
- + No air bubbles
- + Allows analysis by;
 - + Polarized light microscopy
 - + Fluorescence microscopy (some wavelengths)
 - + Raman spectroscopy
 - + Microspectrophotometry (MSP)

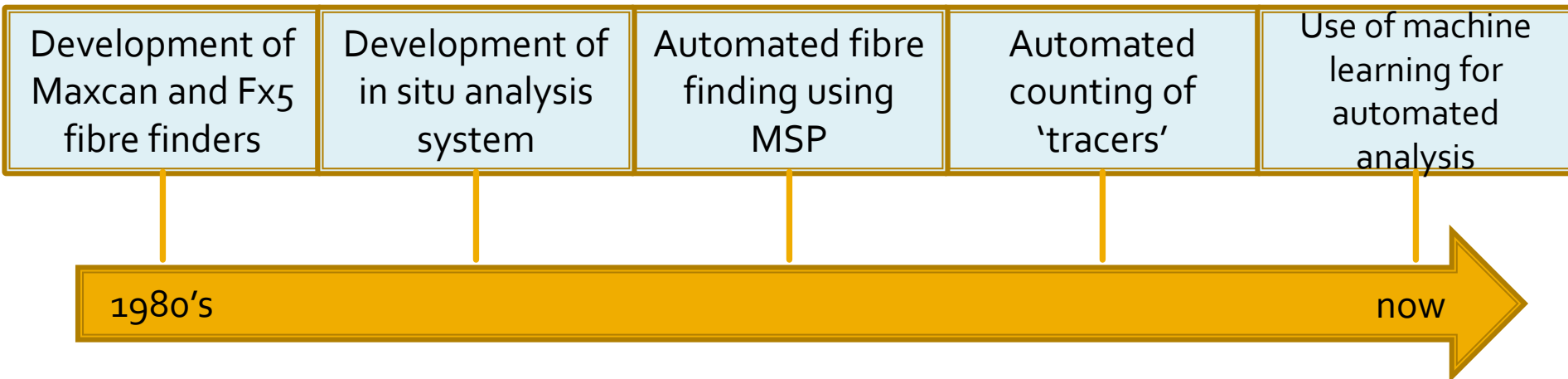
x 400 magnification



Entellan

Easylift

What's next..standardised automated systems...



SHUTTLE 

**SCIENTIFIC HIGH-THROUGHPUT AND UNIFIED TOOLKIT
FOR TRACE ANALYSIS BY FORENSIC LABORATORIES IN
EUROPE**

What will it do...

Tool 1

Tape lifting system

Tool 2

Microscope system
incl. polarized light,
darkfield illumination
spectral information,
Automated extracted

Tool 3

Image processing
Machine learning to
detect, quantify,
characterise
microtraces

Tool 4

Database generation;
Provenance info
Pattern recognition
Allow for source level
information



SPECTRAL360

Automated Detection, Characterisation and Quantification of Microplastics...



Software interface for microplastic analysis, titled "ShowReflectance".

Input: A grayscale micrograph of a sample with a prominent green fiber-like structure.

Output: A line graph showing reflectance values (0 to 1) across a wavelength range (4 to 7). Three curves are plotted: a red curve peaking at ~1.0, a green curve decreasing from ~1.0 to ~0.4, and a cyan curve peaking at ~0.3.

Folder: A file explorer showing a list of image files.

File: A list of files including: 10D1x100.Ni2.N.1.JPG, 10D1x100.Ni2.N.2.JPG, 10D1x100.Ni2.N.3.JPG, 10D1x200.Ni2.N.1.JPG, 10D1x200.Ni2.N.2.JPG, 10D1x200.Ni2.N.3.JPG, 10D1x200.Ni2.N.4.JPG, 10D1x400.Ni2.N.1.JPG, and 10D1x400.Ni2.N.2.JPG.

Preview: A smaller version of the input image.

Buttons: Load Image, Select Point, HDR, Clear Plots.

Plot: A histogram showing the distribution of pixel values, with a peak around 0.

Bottom Panel: A grid of images showing the detection and segmentation of the green fibers from the input image.

Thank you for
listening!

For more information;

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Dr Mohamed Sedky,
m.h.sedky@staffs.ac.uk

Twitter: @Staffsmicro



Thank
You