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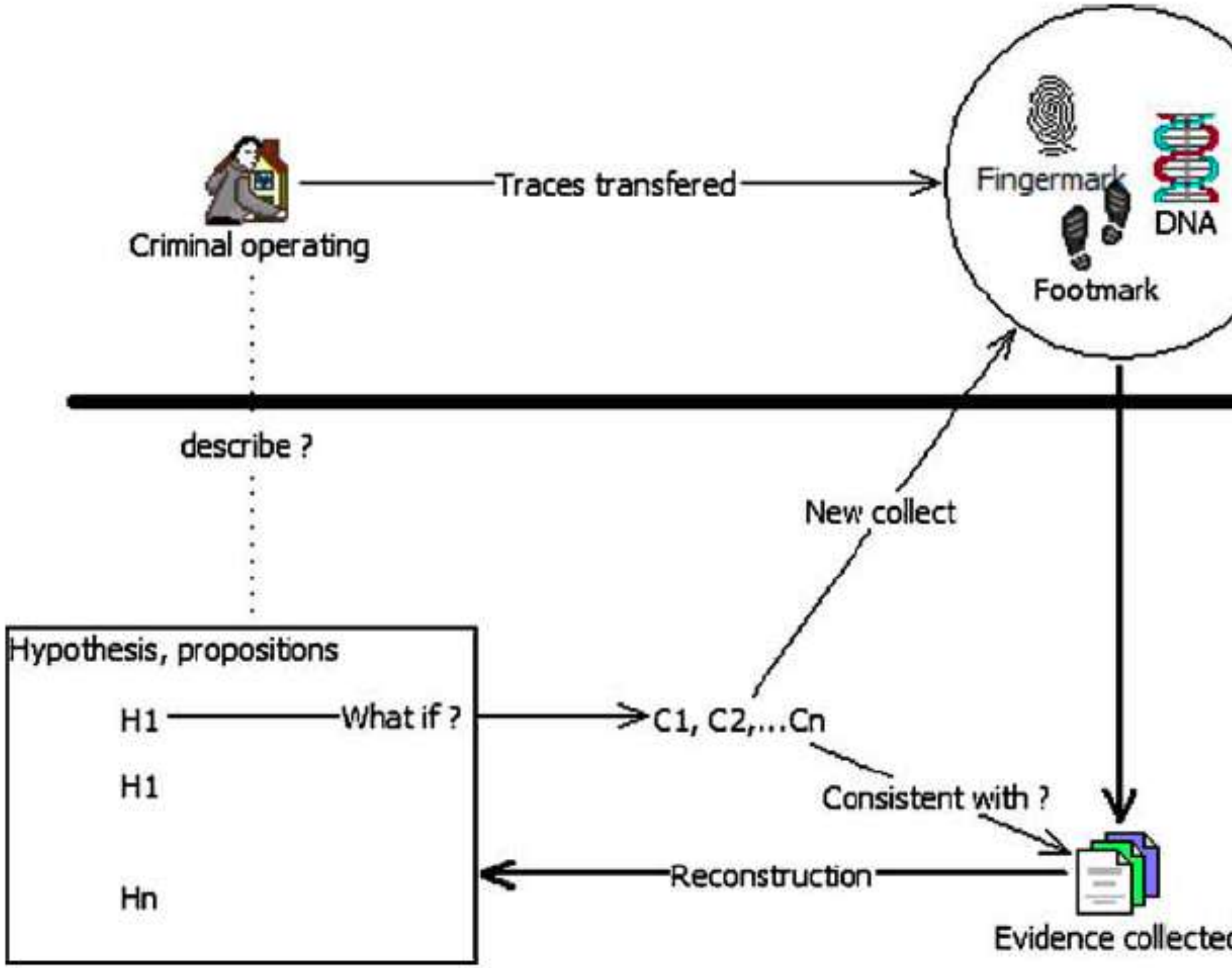
# Glitter – The Ideal Trace Evidence?

Richard Kam, Linda Xiao, Xanthe Spindler,
Philip Maynard, Claude Roux

Centre for Forensic Science, University of
Technology, Sydney, Australia




*Ribaux O., Baylon A., Lock E., Delémont, O., Roux C.,., Zingg C., Margot P. Intelligence-led crime scene processing. Intelligence and crime scene. Forensic Science International 199 (2010) 63–716.*

# Introduction

- Glitter is a man-made piece of aluminium foil or plastic that is cut up into tiny individual pieces.
- Cut into shapes such as hexagon, square or rectangle. Some special shapes can also be cut.
- Around for many years but was not used frequently.
- However, in today's society it can be found in a large range of products.
- Recently, it has been involved in criminal cases and has been used as evidence.

# Introduction

- Ideal trace evidence:
  - Nearly invisible; glitter is so small, it is hard to see under normal conditions.
  - High probability of transfer and persistence; glitter is small and lightweight.
  - Highly selective; glitter can be categorised into various sub-classes (such as shape, size, thickness, colour, etc.).
  - Quickly and easily collected, separated and concentrated; glitter can be tape lifted and searched with hand held lighting.
  - Easily characterised; similar to “highly selective”.
  - Computerised database capability.

# Aims

- Characterise and differentiate the glitter products, including within the Australian markets and manufactures.
- Determine the types of techniques to be used for glitter examination with their relative value and limitations.
- Provide information on the brand, country, colour, shape, etc. for the purpose of identification using these techniques.

# Materials and Methods

## Samples

- A total of 239 glitter samples (120 glitter samples provided by Bob Blackledge and purchased in Australia).

Table 3. Country of Manufacture and brand of glitter samples

| Brand of Glitter Sample | Country of Manufacture | Number of Glitter Samples | Obtained from |
|---|---|---|---|
| Meadowbrook Inventions | United States of America | 120 | Bob Blackledge |
| Celebrations of Australia | United States of America | 84 | Lincraft |
| Zing! | United States of America | 5 | Spotlight |
| Jones Tones | China | 9 | Spotlight |
| Fizz | China | 13 | Spotlight |
| Martha Stewart | Korea | 3 | Spotlight |
| Unknown from Dollar Shop | Unknown | 5 | Dollar Shop |

# Materials and Methods

## Approach

- Optical examination under low power stereomicroscope.
- Objective colour measurement by microspectrophotometry.
- Comparison microscopy and surface texture.
- Fourier Transform Infrared (FTIR) in Attenuated Total Reflectance (ATR) mode.
- Construction of database using FileMaker Pro 11.
- Blind tests.

# Results & Discussion

General

- No glitter samples were found to be manufactured in Australia. Mostly manufactured in United States of America and China.
- Results tabulated into excel based on shape, colour, size and area.
- Assorted into common classes.

# Results & Discussion


Figure 1. Number of colours (%) in the glitter samples (the percentage does not add up to 100% because samples had more than one colour in the sample)

# Results & Discussion

- Well known limitations associated  with colour determination.
- Colour can be affected by different lighting conditions, angle of observation, properties of the various plastic layers and colour shifting effects.
- Common classes or microspectrophotometry.

# Results & Discussion

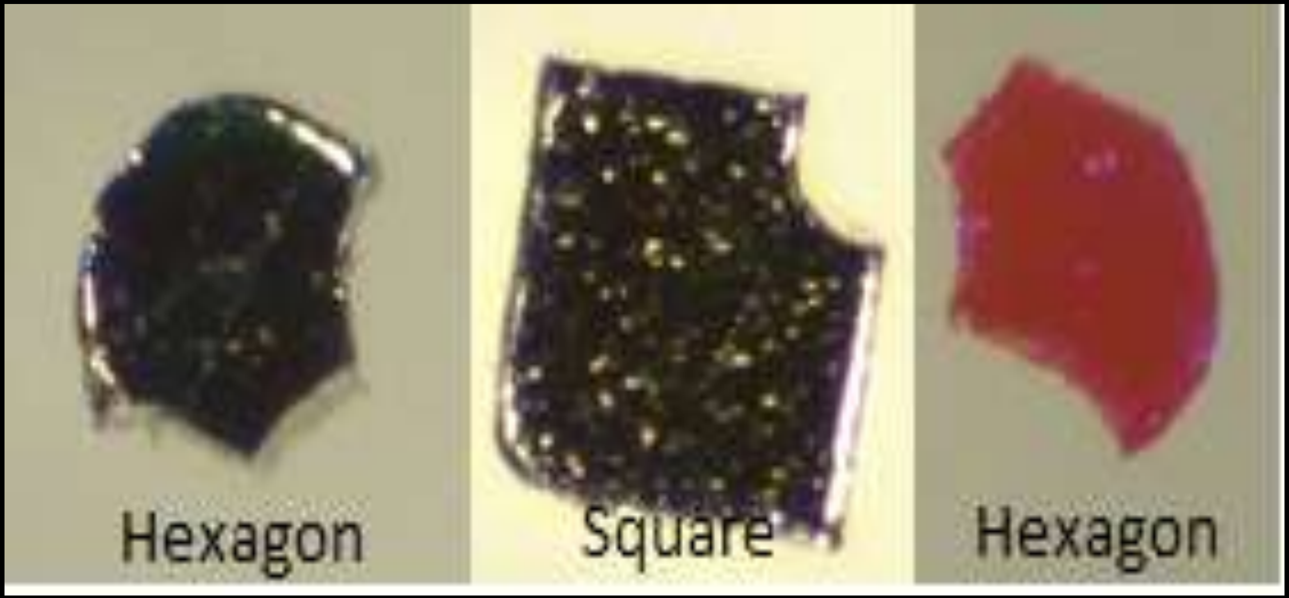



Figure 2. The different irregular common shapes

# Results & Discussion

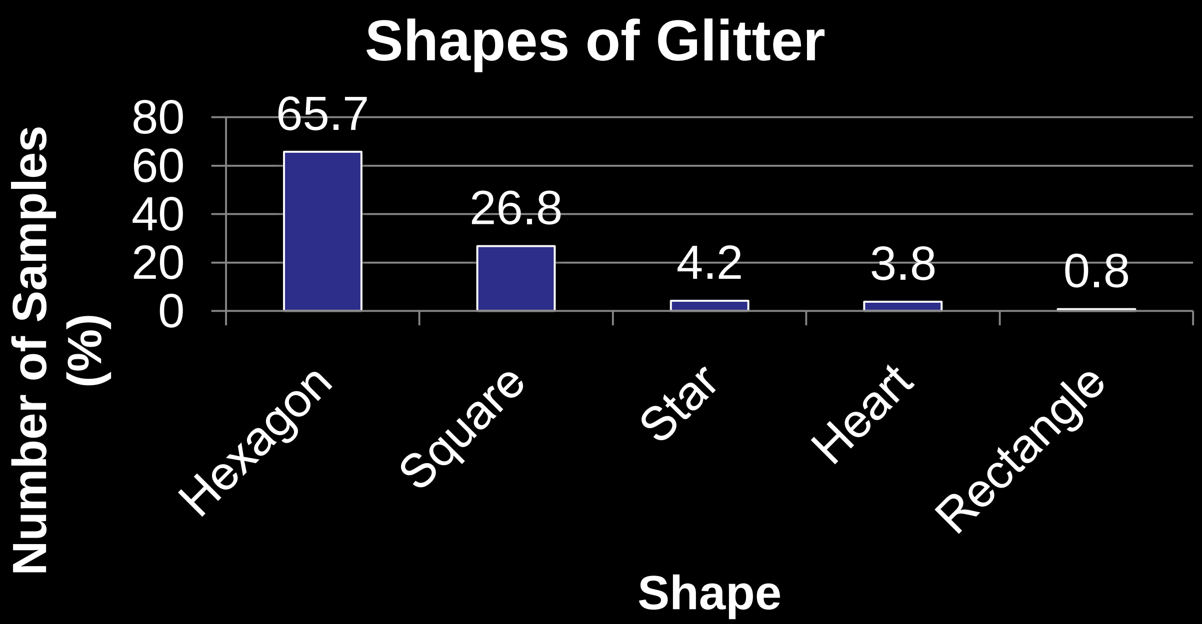



Figure 3. Number of shapes (%) in the glitter samples (the percentage does not add up to 100% because some samples had more than one shape)

# Results & Discussion

- Shape only, the hexagon glitter samples would consider to have fairly low evidential value due to its frequent appearance.
  - Confirm studies by Aardahl, 2003; Aardahl et al., 2005 and Kirkowski, 2003.
- Other shapes such as star, heart and rectangle would have better evidential value due to their less frequent appearance.

Aardahl, K. 2003, *Evidential Value of Glitter Particle Trace Evidence*, Master's Thesis, Natioal University, San Diego, CA, USA.
Aardahl et al. 2005, 'A target glitter study', *Science & Justice*, vol. 45, no. 1, pp. 7-12.
Kirkowski, S. 2003, The Forensic Characterization of Cosmetic Glitter Particles, Master's Thesis, National University, San Diego, CA, USA.

# Results & Discussion


Figure 4. Top row shows how the size of each type of shape was measured and the bottom row shows how the area of each shape was measured (LAS V3.6 software).

# Results & Discussion

Microspectrophotometry

- All the absorbance region followed the optical colour observation.
- Little discrimination within the same colour group.

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# Results & Discussion

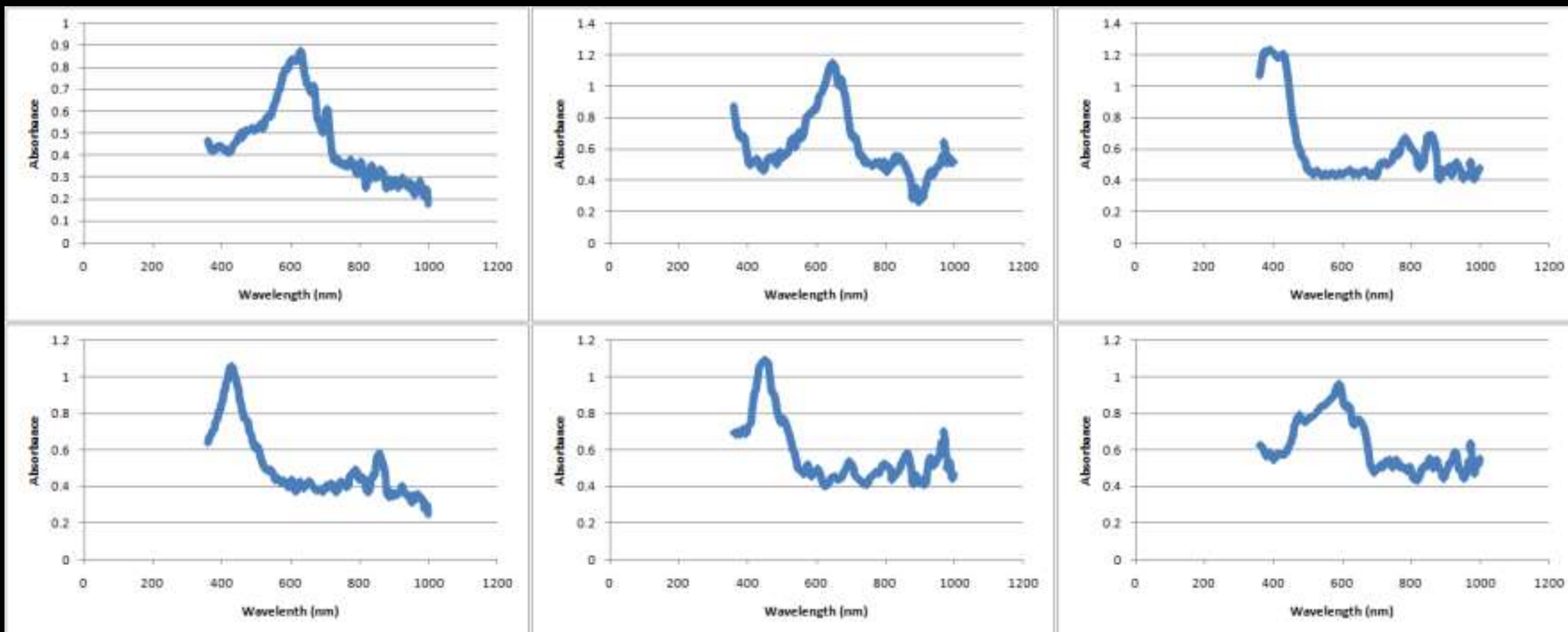


Figure 5. Microspectrophotometry showing that these samples have two different absorbance (Left is C#09, middle C#17 and right is Fizz Crystal #1)

# Results & Discussion

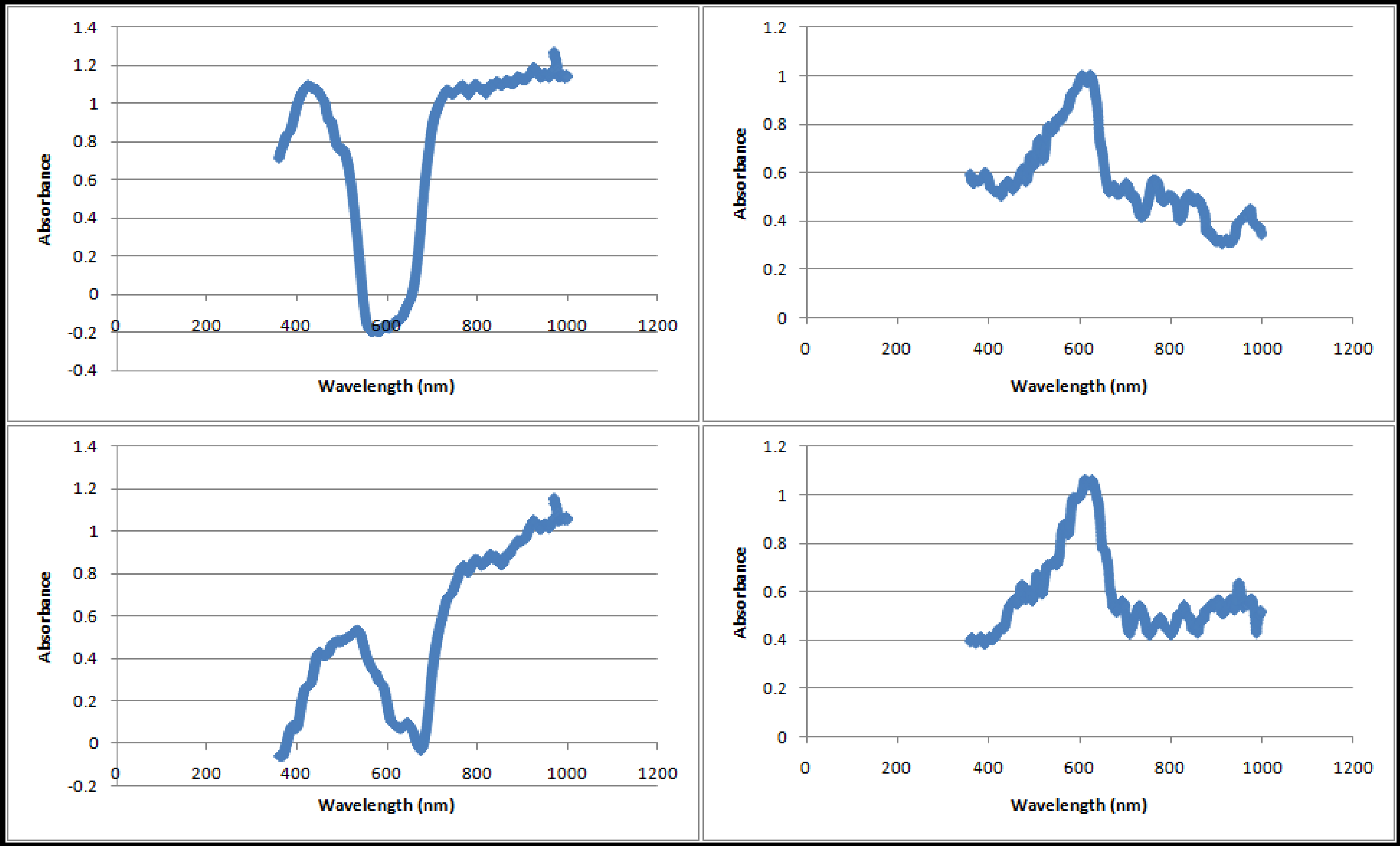


Figure 6. MSP spectra of different blue glitter samples (left top - C#21, left bottom - C#22, right top - C#12 and right bottom - #041)

# Results & Discussion

## Fourier Transform Infrared (FTIR)

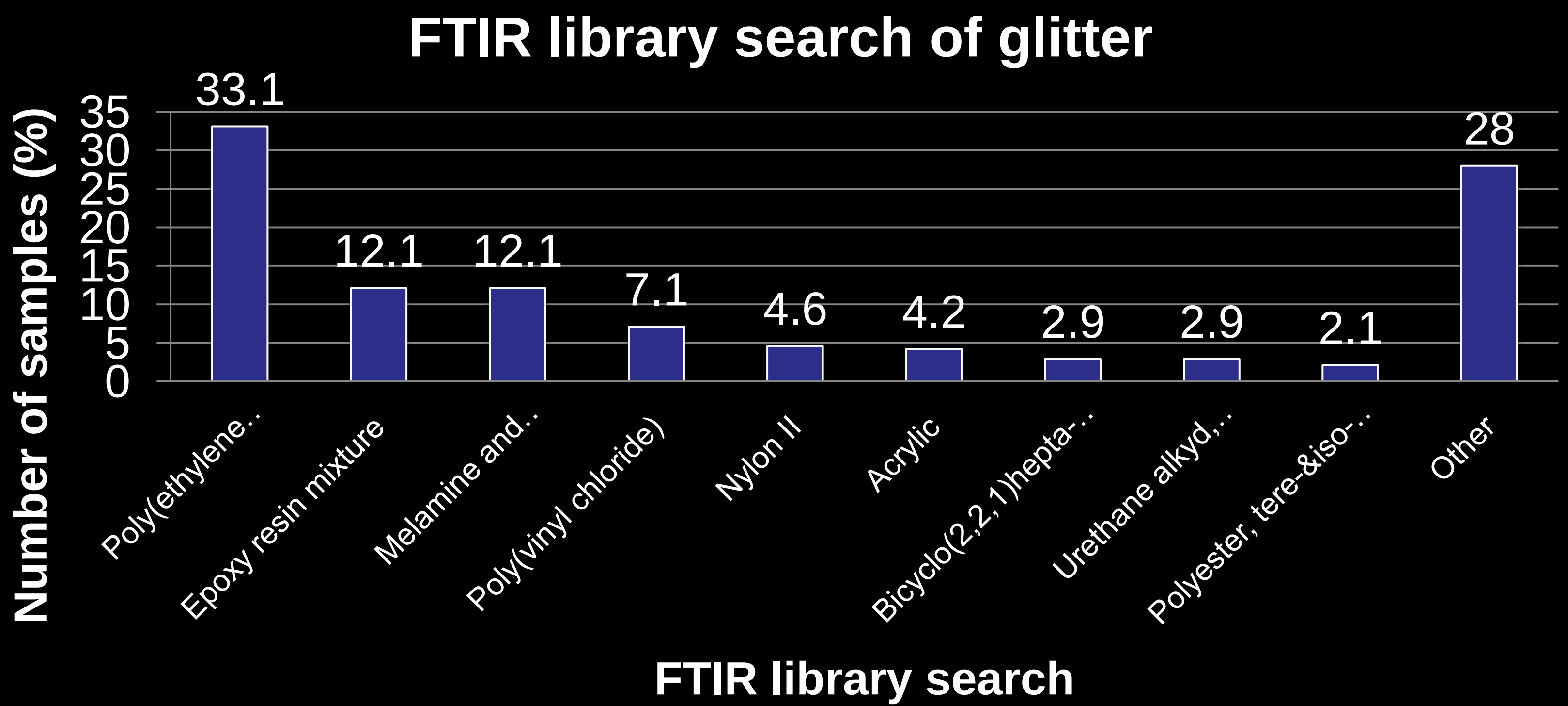


Figure 8. Number of different polymers (%) found by the FTIR library search of each glitter sample (the percentage does not add up to 100% as some samples had more than one substance)

# Results & Discussion

- When grouped according to their brand names:
  - Poly(ethylene terephthalate) (PET) - mainly in the American products;
  - Other countries mainly used other polymers (i.e. epoxy resin mixture or melamine and phenolic resin mixture).

# Results & Discussion

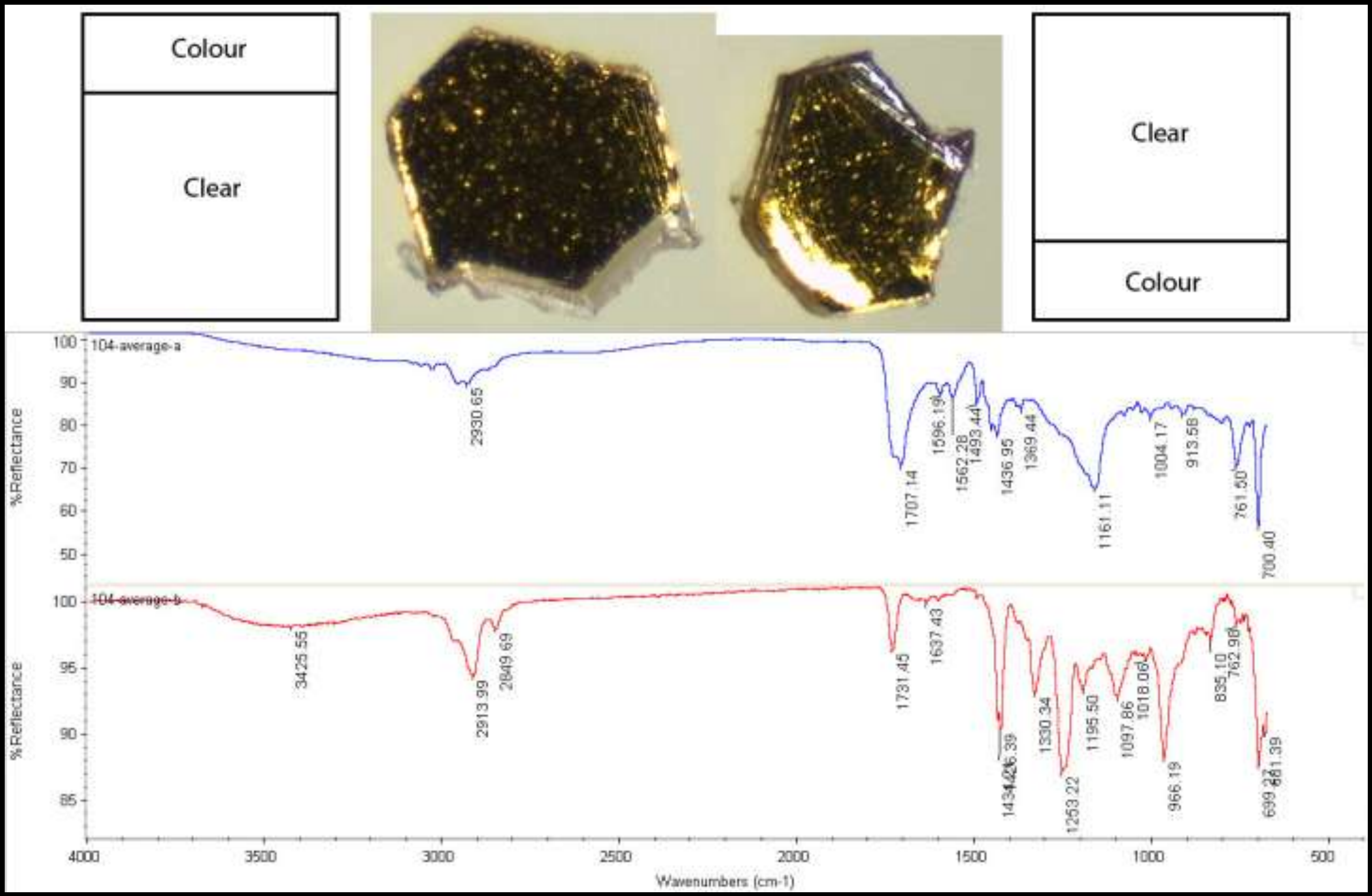


Figure 10. FTIR spectra of #104 glitter sample as analysed on different sides, giving two different spectra

# Further Possible Instrumental Analyses

- Raman microspectroscopy, especially for the analysis of the inner layers of the glitter;
- Scanning electron microscopy/Energy dispersive spectroscopy (SEM/EDS) or another elemental analysis;
- Density by Magnetic Levitation:
  - 11 glitter samples classified in 3 categories (Lockett et al, submitted to JFS)

# Results & Discussion

## Database

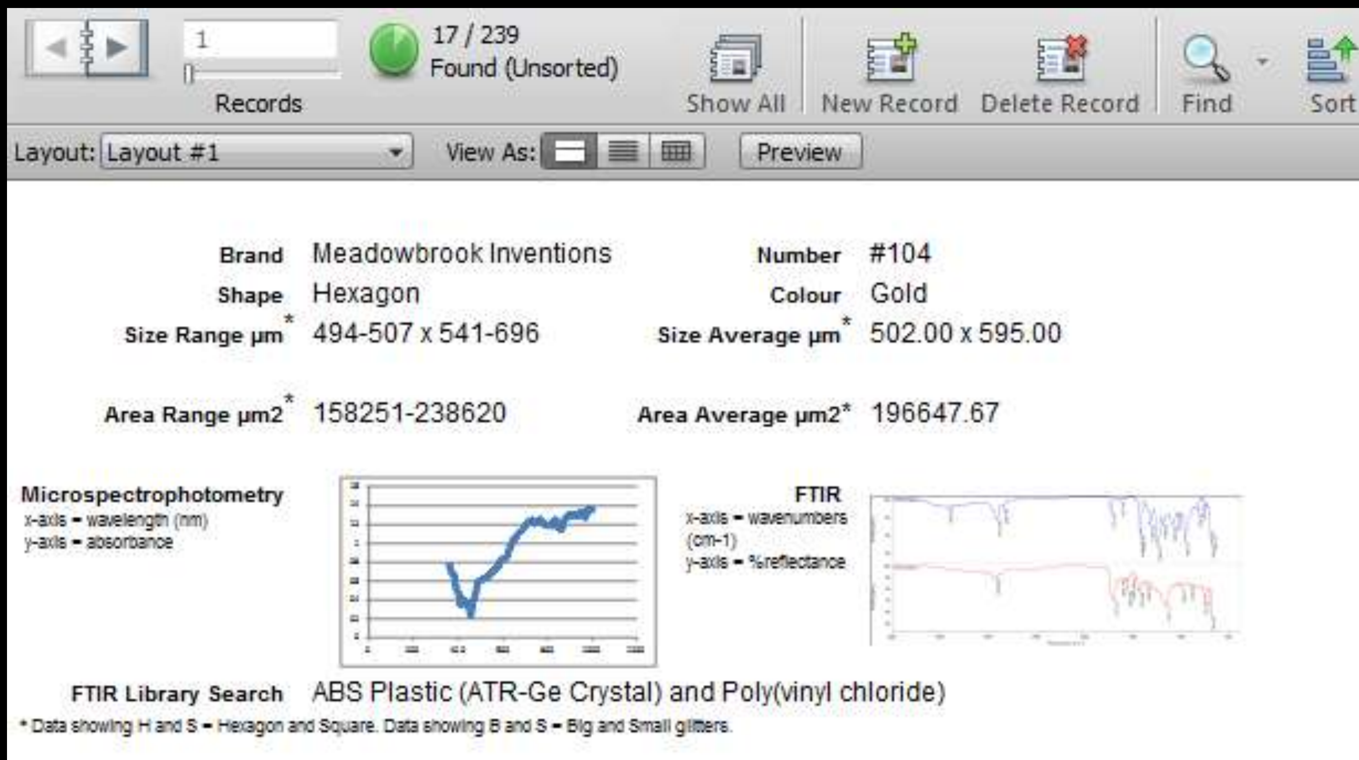


Figure 11. Layout of Database

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# Results & Discussion

## Blind Test

- Carried out to test the accuracy of the database constructed.

| Blind Test | Result Obtained | Correct Result |
|---|---|---|
| #1 | C#21 | C#21 |
| #2 | #074 | #074 |
| #3 | #137 | #137 |
| #4 | Fizz Crystal #9 | Fizz Crystal #9 |
| #5 | JT#6 | JT#6 |
| #6 | C#17 | C#17 |
| #7 | JT#3 | JT#3 |
| #8 | #055 | #055 |
| #9 | C#22 | C#22 |
| #10 | JT#2 | JT#2 |
| #11 | Fizz Crystal #12 | Fizz Crystal #12 |
| #12 | #046 | #046 |
| #13 | JT#1 | JT#1 |
| #14 | C#01 | C#01 |
| #15 | #132 | #132 |

# Recommended Sequence

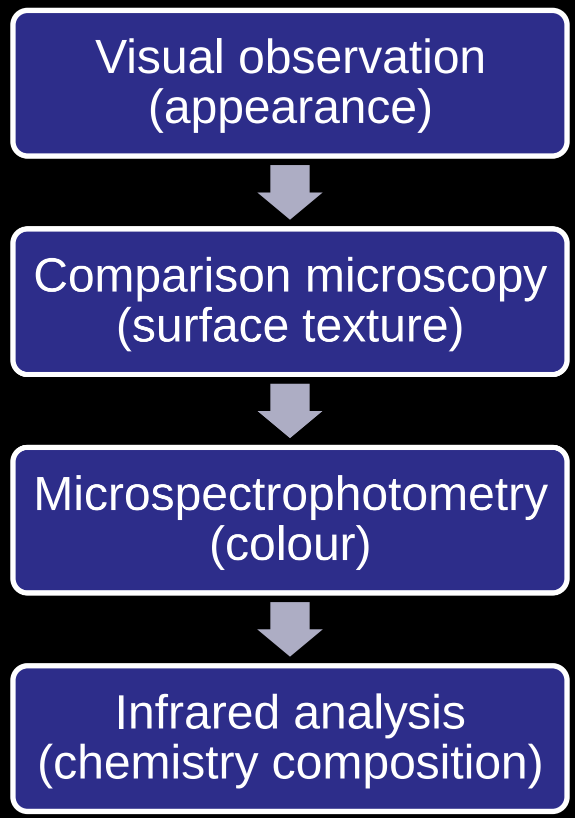


Figure 13. Sequence of approach for glitter analysis

# Conclusion

- Variety of brands of glitter were characterised via optical, physical and chemical techniques.
- Microspectrophotometry was used to give an colour objective measurement for better comparative result.
- FTIR was the most discriminating technique due to its chemical composition analysis.
- Blind test were identified correctly with the help of the constructed database.

# Recommendation

- Further development of the database, including addition of information regarding:
  - A layers section;
  - A specific gravity section;
  - Raman microscopy;
  - SEM/EDS.
- Transfer, persistence and prevalence experiments.

# Acknownledgement


- Bob Blackledge for providing some of the samples and general advice .

# Additional References


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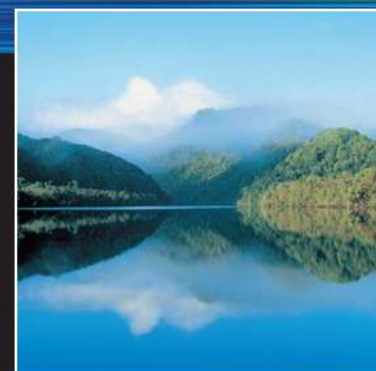


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