Near Infrared (NIR) Spectroscopy within the Plastics Industry

Brian Schmatz, PhD

Business Development Manager

Vinyl Recycling Summit

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Self Bio

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PhD Polymer Chemistry
Research on Polymers for
Printed Electronics

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R&D Scientist – Effect Pigments for Cosmetics & Coatings

Corporate Sustainability Specialist

New Business Development – trinamiX Optical Imaging Devices

We are trinamiX

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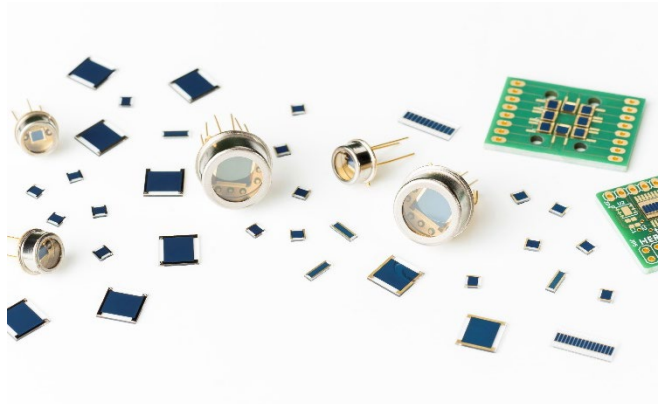

- Spin-off and wholly-owned subsidiary of BASF SE
- Founded 2015 in Ludwigshafen/ Germany
- A team of 137 dedicated specialists
- 346 patent applications and 120 granted patents
- ISO 9001:2015 certified

Mobile spectroscopy allows flexible sorting of materials at the collection station

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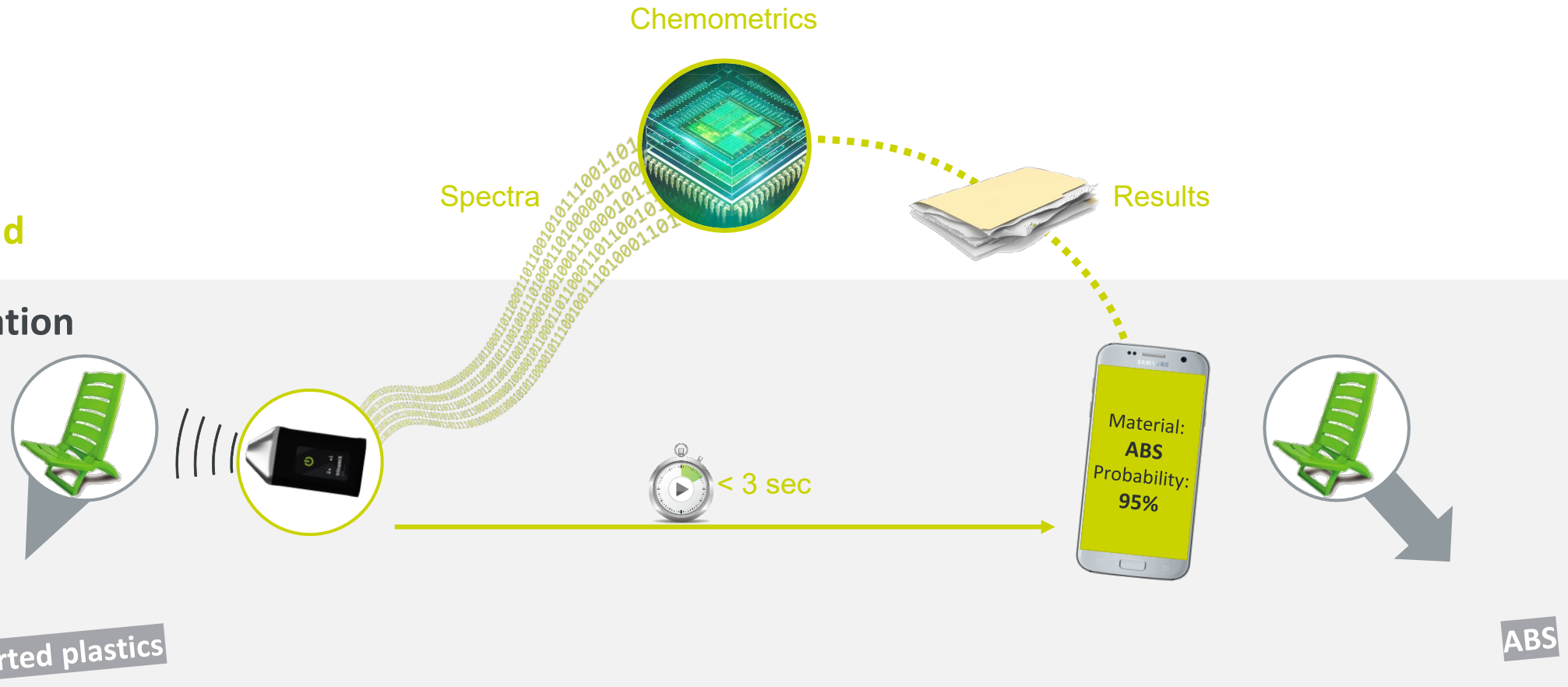

NIR Applications in the Plastics Industry

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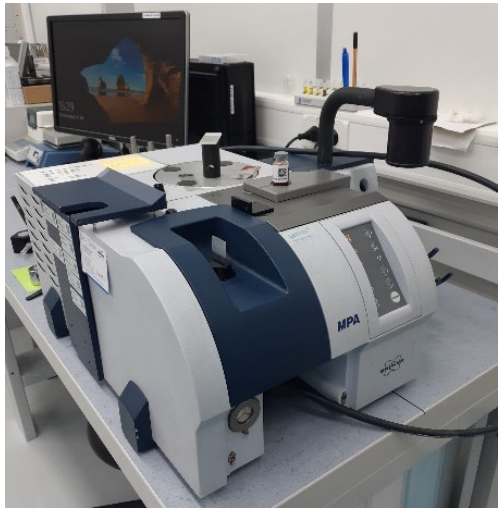
High throughput plastic waste sorting

High throughput flake sorting



Research Instrument for Polymer Properties
(e.g. monitoring of degree of curing)

Handheld Plastic Identification
+ Research Instrument


BANANA COLOR VS. RIPENESS
UNDER
RIPE
OVER

Basics of Light

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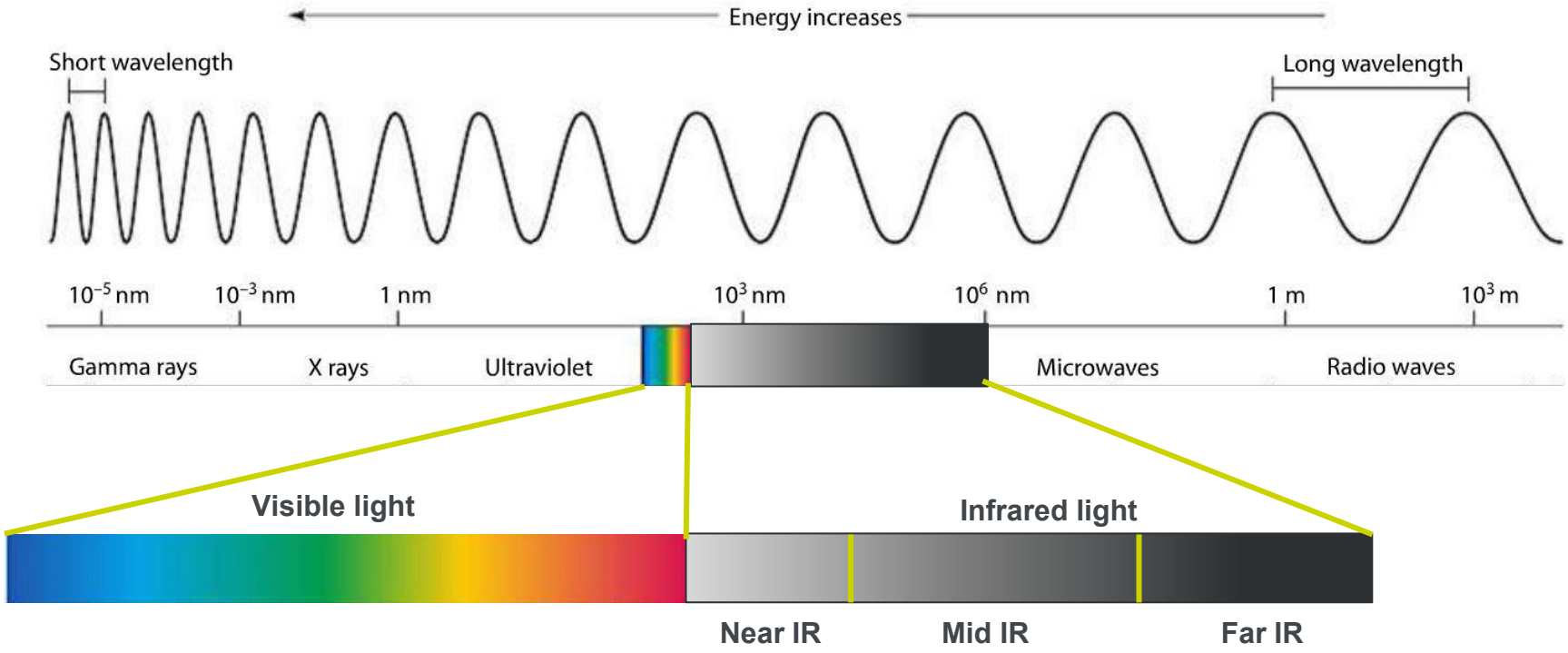

What our eyes can see

Require sensors to “see”

Spectroscopy

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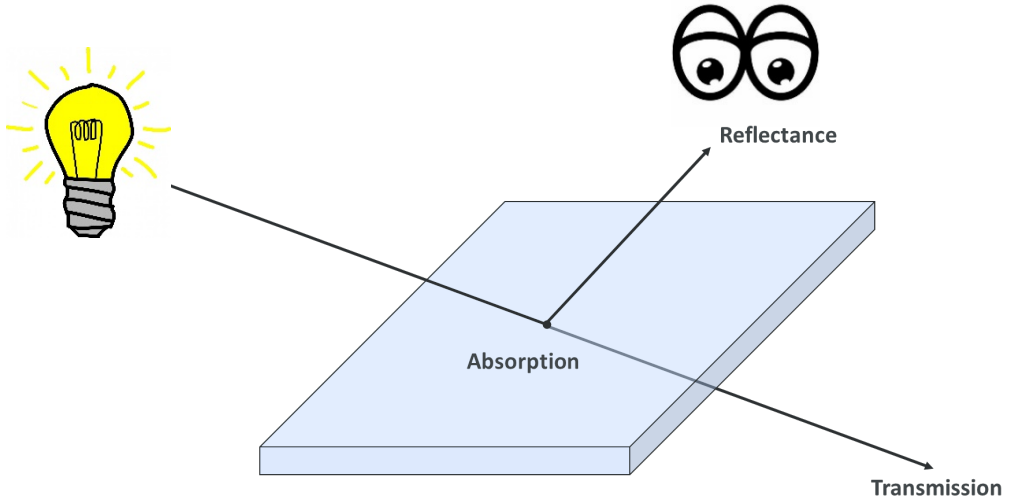

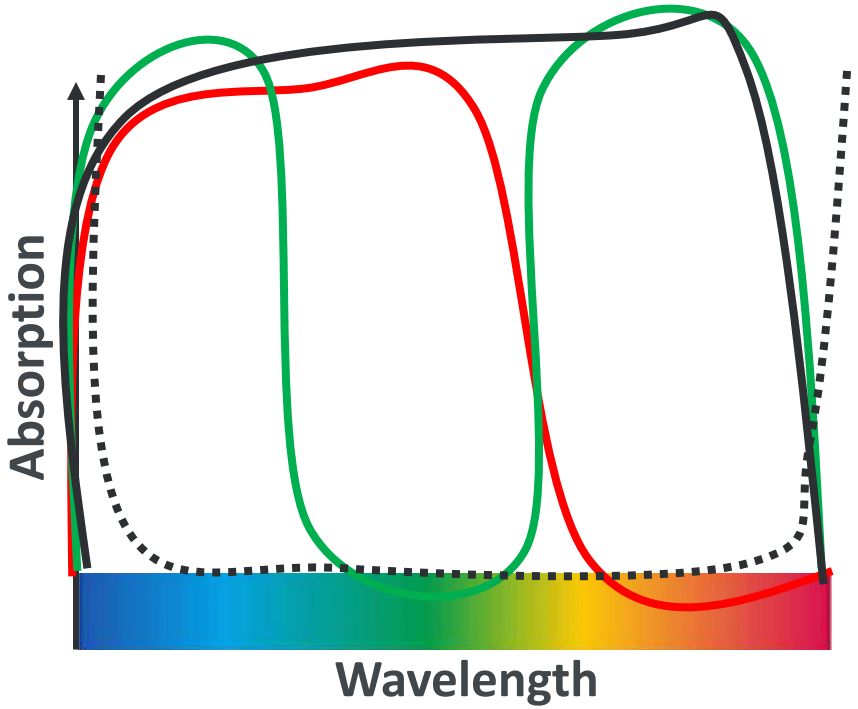

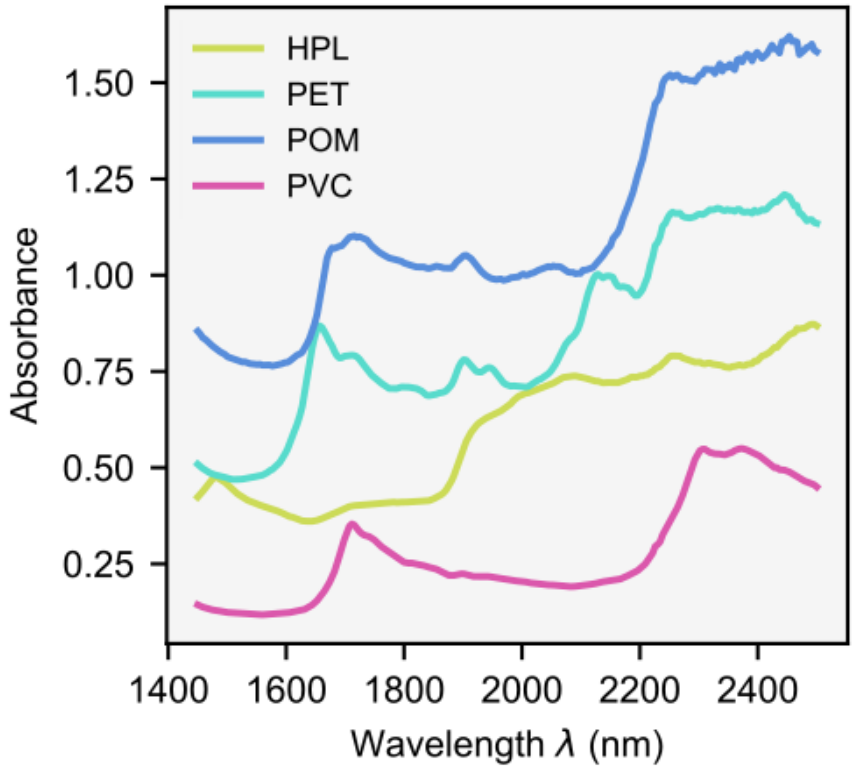

NIR Spectroscopy

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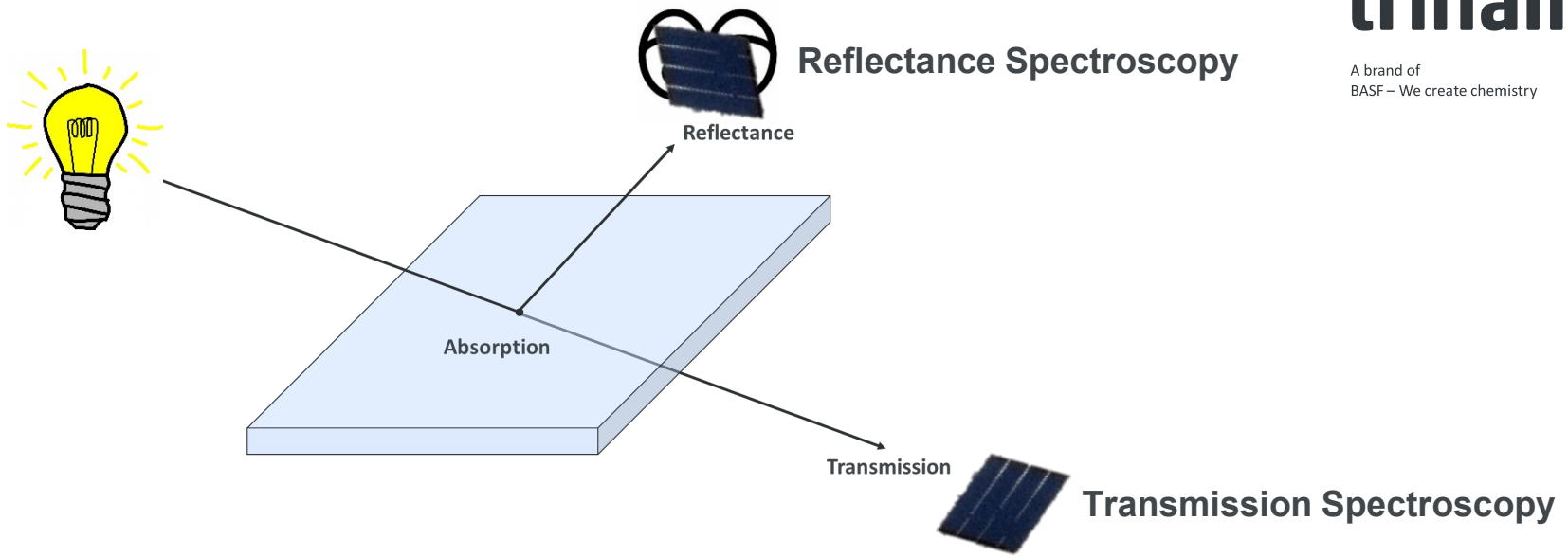
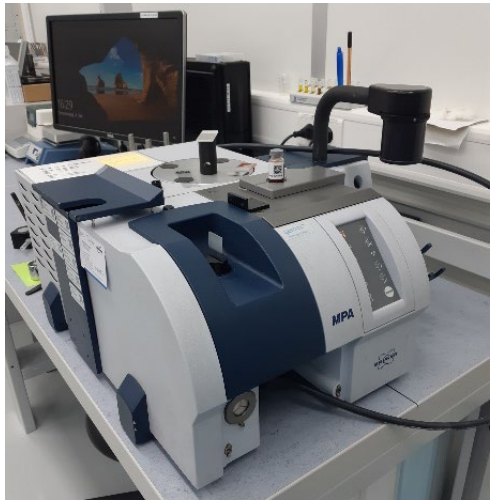
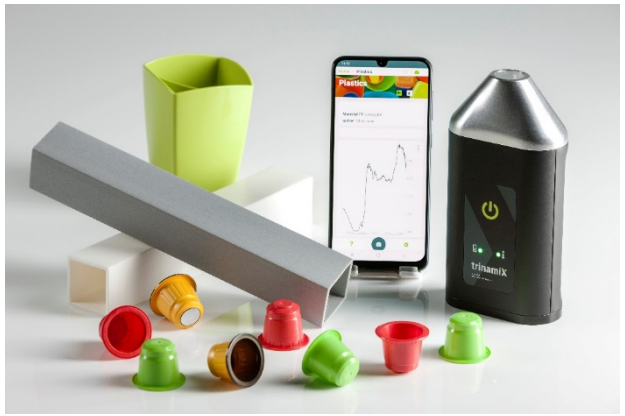




Research Tool
Collect Data
Understand Properties

In-line Tool
Rapid Decision-Making



Research + At-line Tool
Rapid Decision-Making
Collect Data + Understand Properties

NIR Spectroscopy

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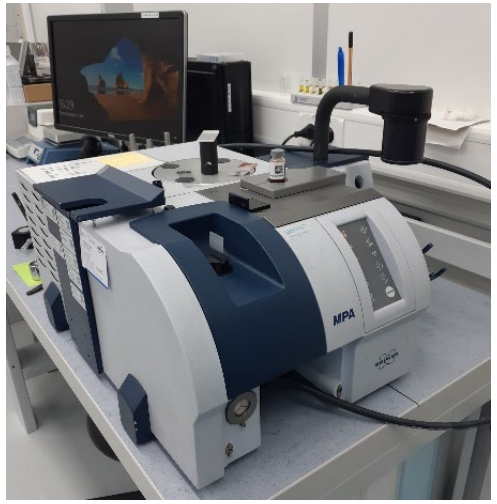
Probing



Research Tool
Collect Data
Understand Properties

Predicting

In-line Tool
Rapid Decision-Making

Probing + Predicting

Research + At-line Tool
Rapid Decision-Making
Collect Data + Understand Properties

Chemometrics – Prediction Models

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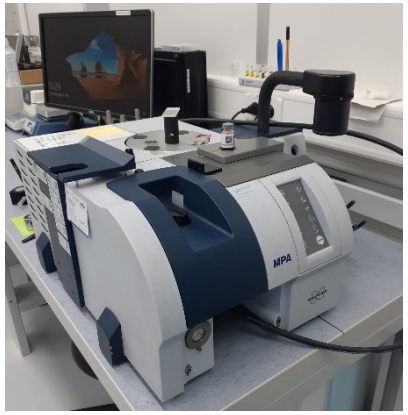
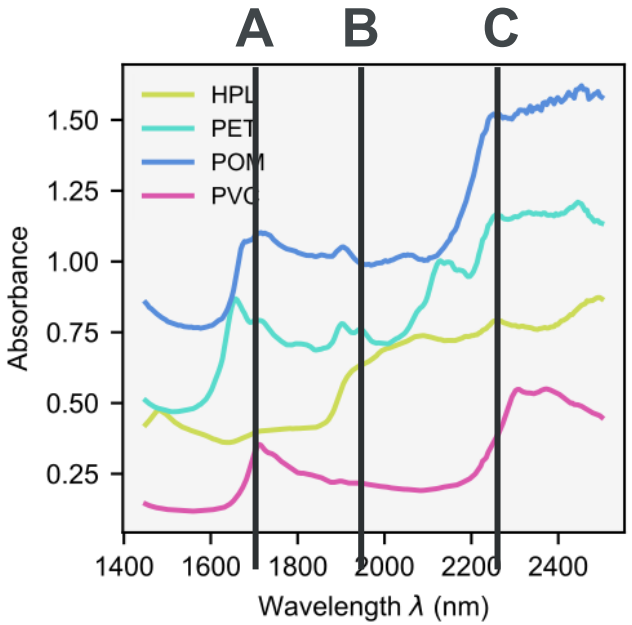


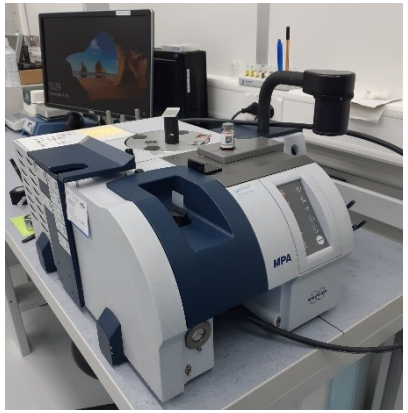
Analyze Known Samples



Plastic ID Model

(A + B) / C =

1 → HPL
2 → PET
3 → POM
4 → PVC



Analyze Unknown Samples

Run Plastic ID Model

(A + B) / C = 2

Predictive Result

PET

Chemometrics – Prediction Models

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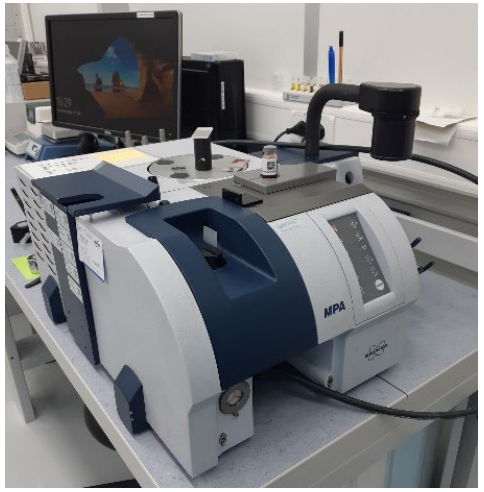
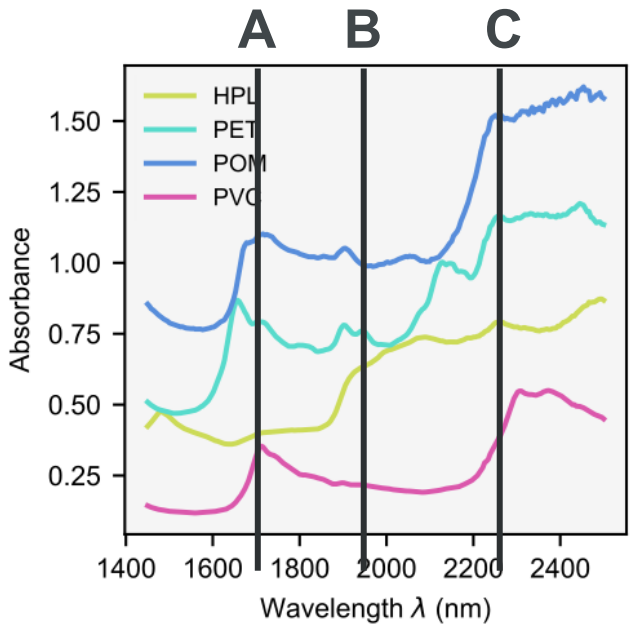
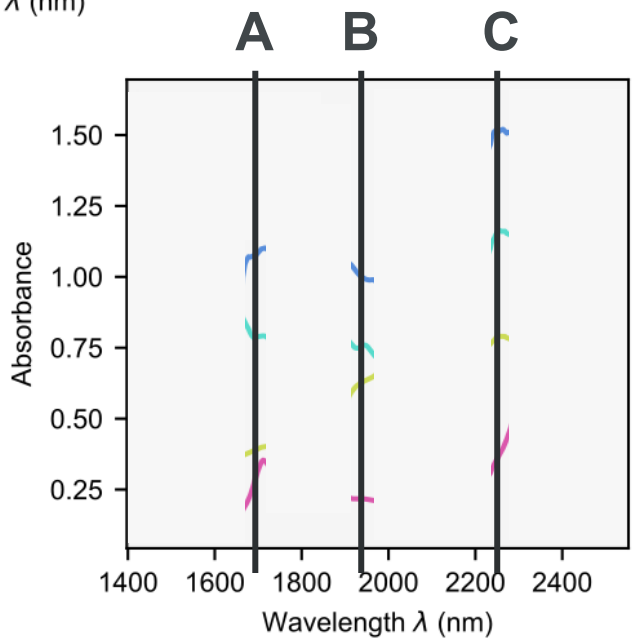




Research Level

- Slower sampling speed
- High quality, full spectrum data
- Higher accuracy
- Higher Versatility



In-line Level

- Fast sampling speed
- Discrete spectral data
- Less Versatile

The black plastic problem

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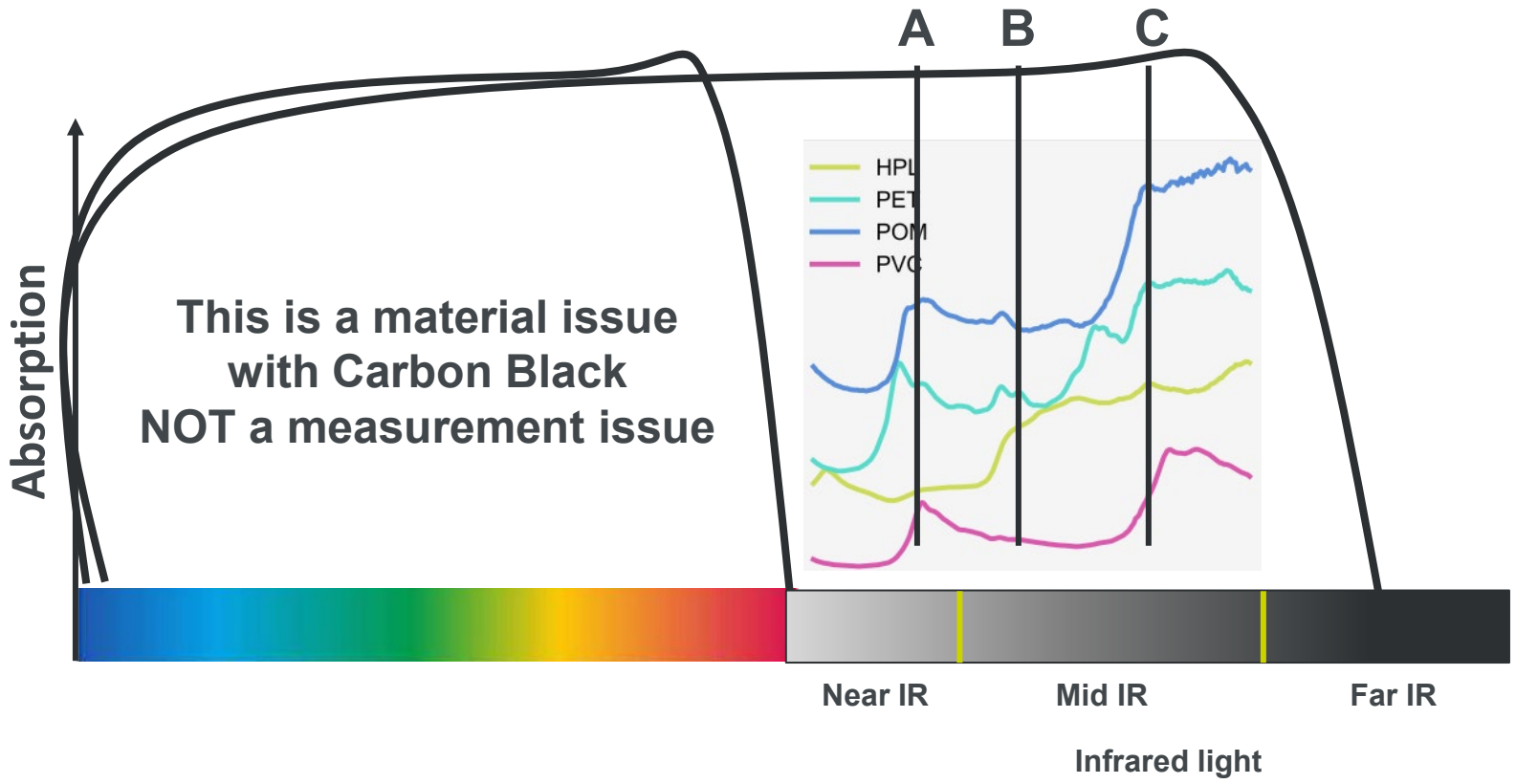
Black pigments are designed to absorb all light, which presents an inherent hurdle for optical sorting



Plastic ID Model

(A + B) / C =

1 → HPL
2 → PET
3 → POM
4 → PVC

With black pigments
→ A = B = C

The black plastics problem

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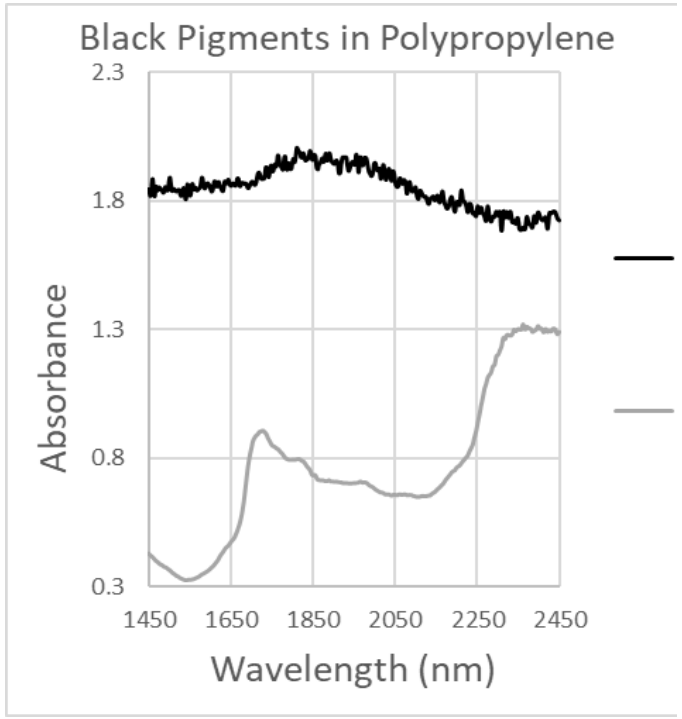

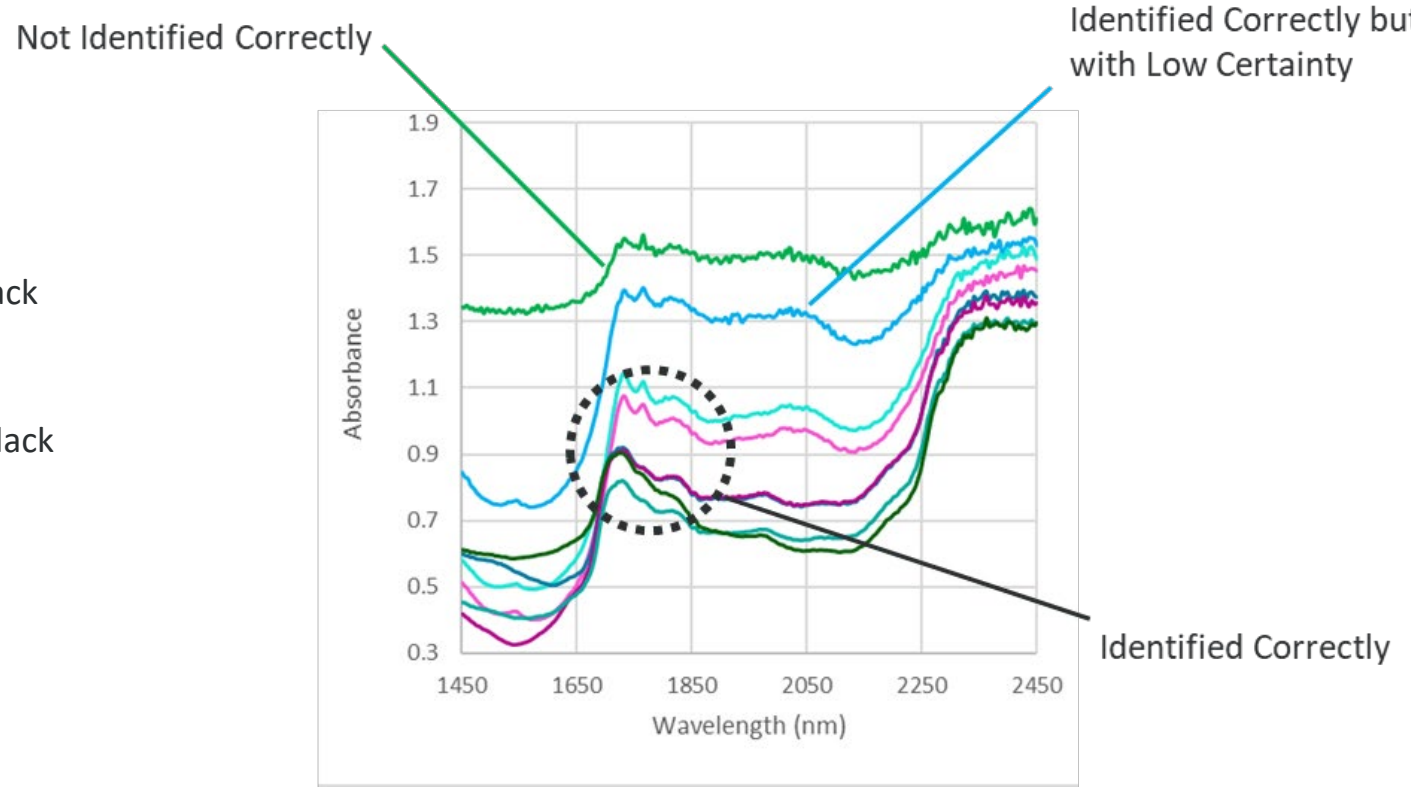

- **New NIR Reflective Black Pigments can solve this issue**
- **Downside is cost + appearance**

- **The Carbon Black issue is not “Black & White”**
- **Some amount of Carbon Black can be OK**
- **Using a probing NIR tool can help determine “sortability” potential**

The label problem

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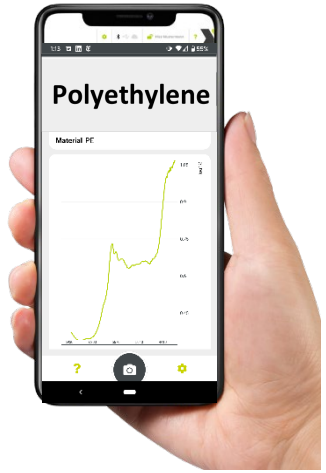
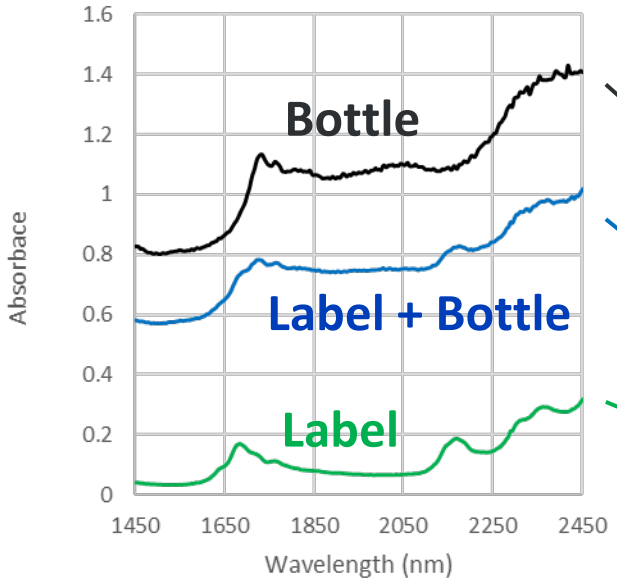
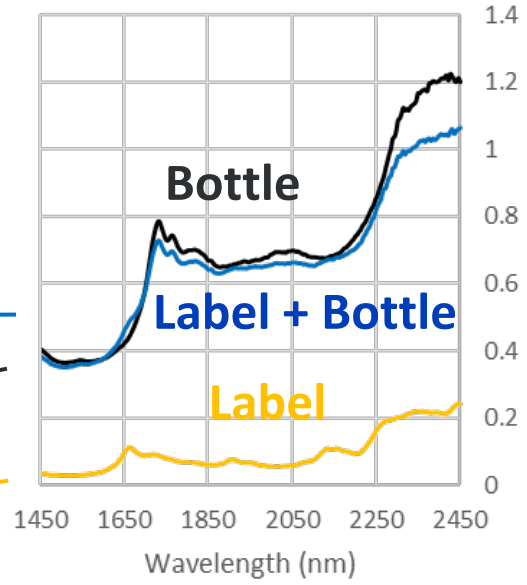
~ 3 seconds



Incorrectly Identified Bottle (PE) through Label (PS)



Correctly Identified Bottle (PE) through Label (PET)



APR NIR Snap Test

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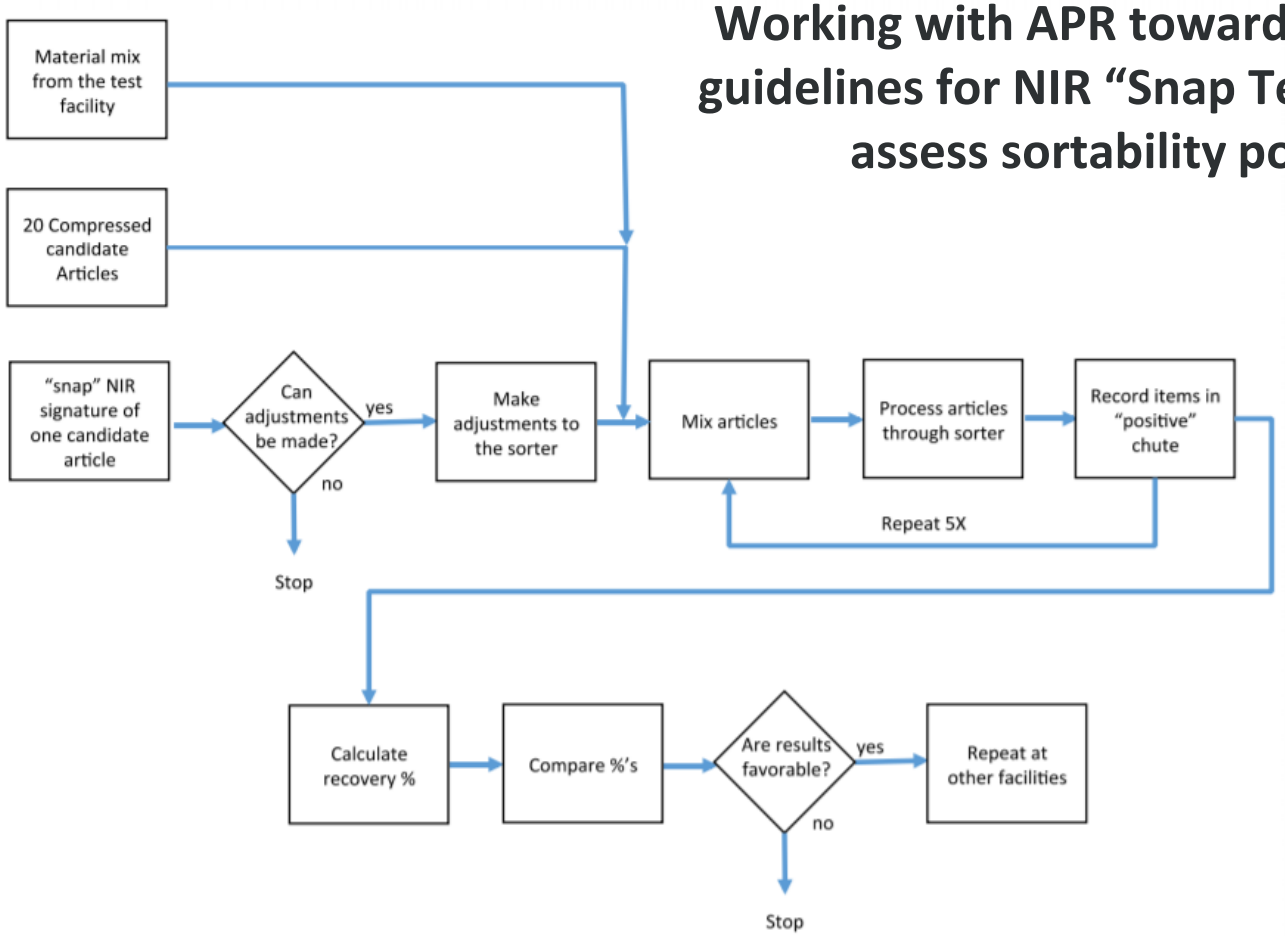
Flow Diagram:



Working with APR towards established guidelines for NIR "Snap Test" to quickly assess sortability potential

Who could use NIR?

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- **MRFs** – NIR is already commonplace for in-line plastic identification/sorting, but handheld/benchtop NIR is a useful tool for troubleshooting odd materials
- **Plastic Recyclers** – NIR flake sorters are commonplace for recyclers, but handheld/benchtop NIR is a useful tool for identifying odd materials during sourcing, upon receiving, and within operations (whole pieces AND flakes)
- **Recycling Depots / Take Back Programs** – affordable handheld units can be used to decentralize plastic sorting at depots or in-store, providing cleaner outgoing streams and creating an engagement point for customers
- **Pigment / Package / Label Designers** – provide a rapid tool for assessing the impact of pigments, labels, or form factor on the sortability of a product → APR NIR Snap Test
- **Resin Producers & Converters** – rapid material assay of inbound/outbound polymeric materials
- **Education / Academic** – useful tool for polymer studies in research & teaching labs, community clean-ups, and general engagement around recycling

Why trinamiX handheld NIR?

- 21 different material classes and growing (PPA, PVDF, MABS, PLA in development)
- Nylon 6 vs. 6,6 – HDPE vs. LDPE – Multilayer vs. Pristine PE (PET & PP in development)
- Continuous model maintenance
- Fast, detailed and direct feedback accessible at point of scan or remotely through online portal
- Useful for Probing AND Predicting Applications
- Easy to use → No PhD required!

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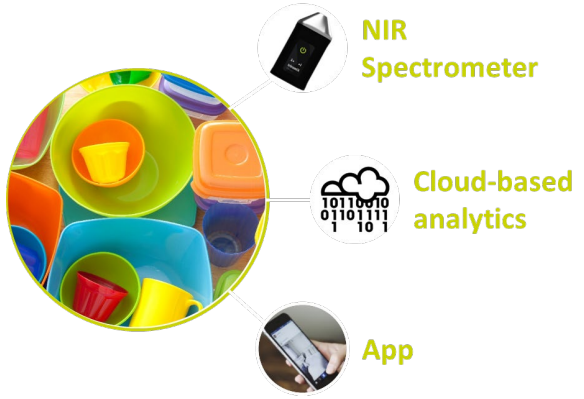
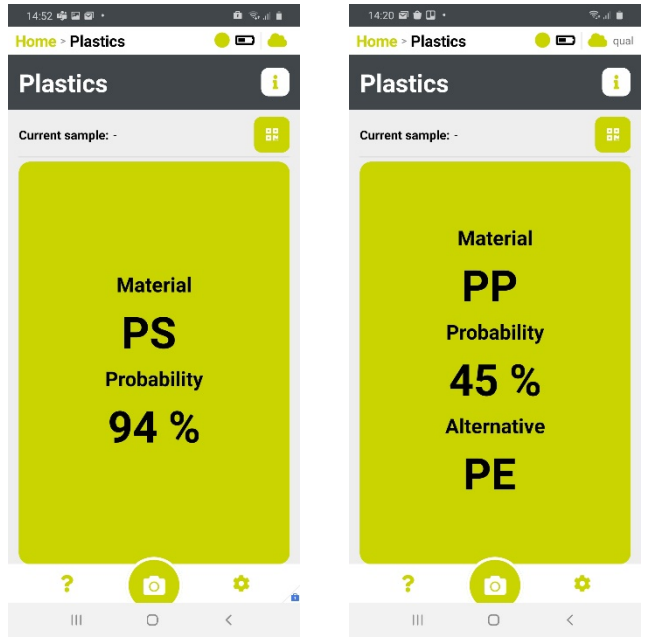
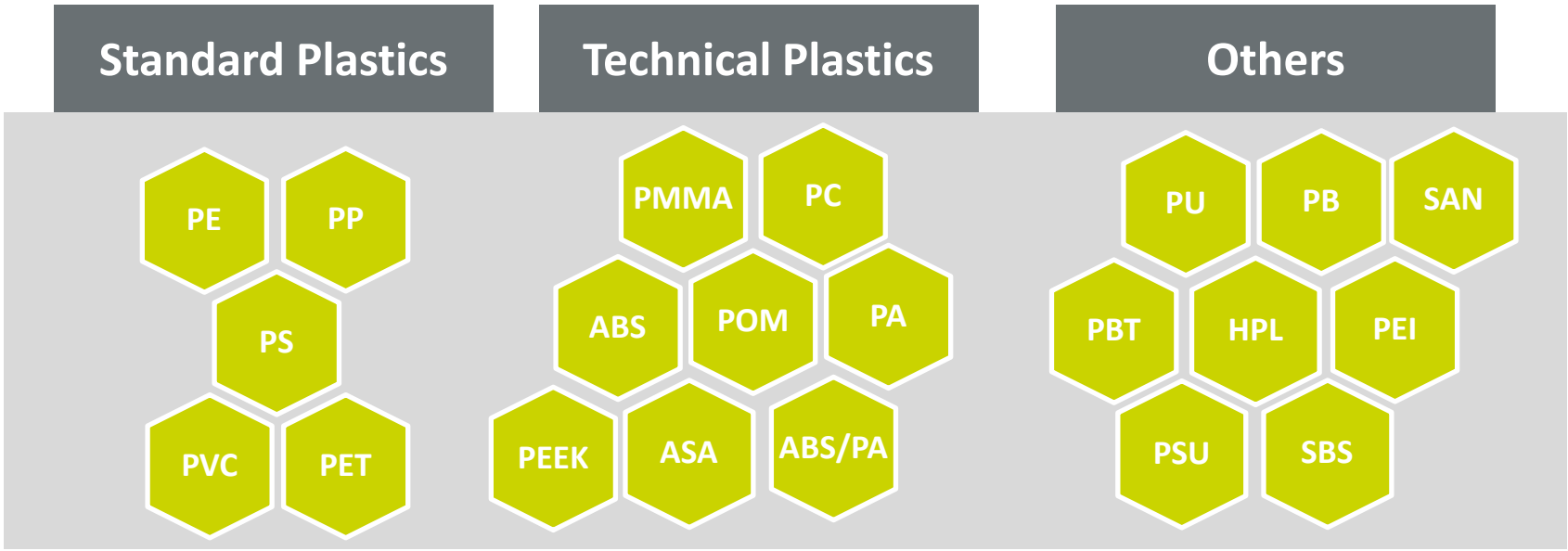


App Output:





Thank you for your kind attention!

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